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GEOGRAPHICAL GEOMORPHOLOGY*

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THE founders of our Association were deeply concerned with physical geography. A rough classification of titles and abstracts of papers presented before the Association during its first seven years, as listed in Volume 1 of the *Annals,* suggests that at least 124 out of 193 titles fell distinctly in the field of physical geography, and at least 70 were primarily concerned with landforms. Some 30 either dealt with the place of geography in education, or could not be classified on the evidence of titles. Fewer than 50 appear to have dealt with distinctly non-physical aspects of geography. The ratio of papers about landforms to those on economic geography appears to have been greater than ten to one.

Examination of the *Annals* or of programs of recent annual meetings indicates a decided shift away from interest in physical geography in general, and from landform studies in particular. Much of this shift should be regarded as an indication of progress. Other branches of geography have been developed. The percentage of physical geographers included in the membership of the Association should drop somewhat in proportion to the expansion of the field of geography as a whole.

The declining interest in physical geography, however, has been not only relative but absolute. Whereas papers in physical geography constituted a majority of titles in all earlier annual meetings, we now find it difficult to assemble enough to permit holding an adequate half-day session in that field. Meteorology, oceanography, geophysics, and hydrology have been practically lost. Climatology may be following. Geomorphology is being developed mainly under auspices other than our own.

There are actually more geomorphologists in the United States today than during the days when our Association had such deep interests in landforms. The Geological Society of America is considering the establishment of a Division of Geomorphology. Some 80 Fellows of that Society appear to be interested in the subject. There is also an active interest in geomorphology in Europe. Plans are well under way for establishing a strong international journal in the field, under the leadership of geomorphologists in the Low Countries. A large percentage of European geographers remains centered in landform studies.

* Presidential address delivered before the Association at its Forty-fifth Annual Meeting in Madison, Wisconsin, December 29, 1948.

The drift away from emphasis on physical geography appears to be most characteristic of American geographers. Much of the old content of physical geography has been developed into several distinct subsciences by persons who pay allegiance to other societies than our own. As far as geographers are concerned, I am under the opinion that many have tried landform studies, and have found them wanting. Three general criticisms may be raised: students of landforms have been (1) unrealistic, (2) too geological in their interests, and (3) they have failed to cover their field.

UNREALISTIC

As an outstanding example of unrealistic attitude, I cite our classical classification of shorelines. Here we encounter, as the main basis of classification, two great categories, emergent and submergent. Completely ignored is the fact that during the last 20,000 years or so sea level has risen about 400 feet, so that there is practically no place along continental or island perimeters where an emergent shoreline could exist.

If we follow the classical classification, we find that for many miles to the east of the Rhône delta there is a beautiful shoreline of submergence, with many deep bays and rocky headlands, while to the west, for most of the distance toward the Spanish border, there is an equally beautiful example of a shoreline of emergence. Here we find long offshore bars flanking lagoons of a low, marshy coast. From this physiographic information we would naturally conclude that there has been a tilting of the coast of southern France. The Rhône valley appears to be an axis separating a depressed region toward the east from an uplifted region toward the west. The "neutral" shoreline of the delta indeed appears to lie in an area of diastrophic neutrality.

Physiography serves us badly if we accept conclusions based on the classical classification of shorelines in southern France. The absurdity of the conclusions is adequately demonstrated by terraces that lie inland. These are older than the present shoreline, yet they are undeformed. Instead of sloping in an eastward direction, they are practically horizontal. The Mediterranean has risen so rapidly during the last 20,000 years that all of its shorelines are submerged. Most of the shores are physiographically drowned. In some places, as to the west of the Rhône Delta, where rocks offer little resistance to erosion, and their débris to transportation, forms have been created which the classical classification regards as evidences of emergence.

The classical classification of shorelines is of little or no use to geographers, or anyone else. It serves well to illustrate the point that students of landforms have been unrealistic. It is firmly rooted, however, and several decades may elapse before it disappears from our text-books.

For a second example of unrealistic attitude, I wish to proceed from a specific case to the consideration of what may be called a cult,—the cult of "pure" morphology. Though many of the deities were Americans, the strongholds of the cult appear to

be centered in other parts of the European World at present. Practitioners follow a creed that the final chapters of landform development may be deduced from study of form alone. Impure is any appeal to evidence that might be furnished by auger, microscope, or geophysics. Profane is aid from geologists, pedologists, botanists, or other untouchables.

The pure morphologist gazes over a broad landscape, classifies its forms according to the rules of a rather complicated terminology, and arrives at conclusions which purport to explain natural landscape evolution. Maps may be consulted freely. In fact they may supplant field experiences entirely.

In England, where pure morphology is making a determined stand, hypsographic standards are shockingly low. The pure morphologist has maps little better than we had for Montana or Wyoming prior to 1920. Contours have been surveyed on 100-foot intervals, and interpolated for intervening 50-foot levels. Aided, or deceived, by such maps the pure morphologists have succeeded in finding widespread and generally undeformed levels at elevations of 200, 400, 600, and 800 feet. The higher surfaces are presumed to date well back in the Tertiary.

In some ways Nature seems to have been kind to pure morphologists. English units of spacing stop at the Channel. Pure morphologists on the Continent find levels arranged according to the metric system, at 100, 200, and 300 meters.

Geographers ordinarily find difficulty in discovering useful information in the conclusions of the pure morphologist. That a particular river is a consequent stream with an obsequent extension, that some part of a river is superimposed rather than antecedent, or that a windgap suggests a case of stream piracy, really means little to the person working on the problems of some specific cultural landscape.

Geologists ordinarily find the results of pure morphology too indefinite to be of value. Practically every interpretation of landform evolution is vulnerable to upset when confronted by facts discoverable in a bore-hole, a seismological survey, or even the finding of a fossil in some unexpected position.

To restrict oneself to studies of form alone, while closing one's eyes to any other type of evidence, is about as sensible as having one's leg amputated before participating in a sprint. Yet we find followers of the cult who actually cultivate a haughty disregard for such things as gravel deposits, Pholas borings, or local contrasts in soils. Their attitude appears to be completely unrealistic.

TOO GEOLOGICAL

A competent geomorphologist must have an adequate geological background. Geomorphology and sedimentology are ordinarily regarded as important branches of physical geology. Geologists have nurtured landform studies and have contributed heavily to our information on the subject. The viewpoints commonly held by geologists are not likely to be those held by geographers. I think that geographers have excellent grounds for regarding most of geomorphology as being too geological for their needs.

When dealing with landforms geologists tend to think in terms of vertical cross

sections rather than of horizontal plans. Land is uplifted, incised, and degraded. Streams corrade vertically when young and vigorous, or laterally when old and tired. Faults and folds commonly uplift or depress. Raised beaches stand at various vertical intervals above sea level.

Many landform studies are undertaken for the purpose of arriving at diastrophic conclusions. The elevated peneplain, variations in the downstream slope of a river terrace, or vertical intervals between terraces in a given valley cross section are matters of greater interest to students of uplift, depression, or warping than to geographers generally.

The geographer, in my opinion, needs much from geomorphology, but in searching literature in the field finds most of his needs unfilled. He seeks accurate, factual information. What landforms actually exist in a given region? How do they differ? Where are they? What are their distributional patterns? The geomorphologist may concern himself deeply with questions of structures, process, and time, but the geographer wants specific information along the lines of what, where, and how much. The distinction between geological and geographical geomorphology lies chiefly in a contrast between conclusions of vertical or of horizontal significance.

The geographical side of the field has been neglected by the geologists who have developed geomorphology. Here and there we find an outstanding exception, and how grateful geographers have been for each case! The generalizations of Fenneman have served us well. They will be expanded into a map of the physiographic regions of the world if a proposal of one of our members, L. L. Ray, which was adopted by the International Geological Congress in London, last summer, is actually put into effect. These small-scale generalizations, however, are by no means the ultimate contribution of geomorphology to geography. Detailed geographical studies need desperately the conclusions of a large-scale, factual geomorphology,—one that explains why a specific hill exists, what parts it has, and how each part differs from others, and that indicates the areal extent of each part; what, where, and how much.

INADEQUATE COVERAGE

The geographer may charge fairly that the geomorphologist has failed to cover his field. Rarely has he found factual, specific information resulting from landform research. Most commonly his experience has been that of finding hazy, theoretical suggestions, or conclusions which are patently erroneous. ~~Classical geomorphology~~ concerned itself almost wholly with erosional forms. Only recently have students turned to matters of mass-movement, or to depositional features.

Widespread flats were likely to be considered as ultimate, or at least penultimate, consequences of erosional activities. In keeping with the traditions of classical geomorphology, together with one of our early members, R. L. Holway, I published, in 1920, a laboratory syllabus that used the Donaldsonville, Louisiana, Quadrangle as its type example of a penepla[illegible]. I was as ignorant as our most widely used textbooks of geology today of the basic fact that the alluvium of the Lower Mississippi Valley is something more than a thin veneer covering a bedrock flat developed by

lateral corrasion. I did not know that even as far north as southeastern Missouri the alluvium reaches depths far beyond the lowest pools scoured by the river, nor that it covers a topography that is anything but flat. Our laboratory syllabus certainly presented an inadequate and erroneous coverage.

In the lower parts of large alluvial valleys, and along coastal plains, many of us encounter territory that was treated horribly by classical geomorphologists. These flats were either dismissed lightly or with a few opinions that rarely jibe with observational fact.

The notion that the broad flood plain of the Lower Mississippi River is related in some way to lateral corrasion is about as far from truth as an idea can be. The surficial flatness is due to deposition alone. The alluvial fill is deep. Beneath this fill is a buried, pre-Recent topography that has been mapped about as precisely as the topography of England. A map prepared by H. N. Fisk, and published in 1944 by the Mississippi River Commission, shows this pre-Recent surface by contours with 25-foot intervals above sea level, and 50-foot intervals below. The lowest points along the river bed in the vicinity of Cape Girardeau, Missouri, were nearly 100 feet deeper in pre-Recent times than are corresponding points today. In southern Louisiana the floor of the pre-Recent valley was more than 300 feet below the floor today. Out some 29 miles on the continental shelf the pre-Recent surface lies generally about 550 feet below sea level.

Borings indicate the fact that waterfalls up to 80 feet in height poured over lips of Paleozoic bedrock into the northern valleys of the buried topography of the Lower Mississippi Valley. The Fisk map shows that beneath the alluvium extending from Cairo, Illinois, to the Gulf is the pre-Recent topography of a rolling country, with an intricate drainage system of sharply incised streams.

One of the interesting facts in connection with this map is that during the seven years since its completion thousands of new penetrations of the pre-Recent surface have been recorded, but no significant change in its contours would be made if a new issue were being published today. Cross sections taken from the data presented by Fisk are so factual that few geologists or geomorphologists realize their significance. The days of the hypothetical and generalized cross section should be brought to a close as soon as competent investigators obtain sufficient financial support for truly factual studies.

Classical geomorphology deduced poorly the subsurface picture of the Lower Mississippi and many other great alluvial valleys. Its conclusions furnished geologists with some erroneous ideas about diastrophism. It closed its eyes as tightly as possible to the extremely important facts substantiating a reciprocal relationship between volumes of oceanic waters and continental ice. How useful was it to the geographer? What heritage enriched the backgrounds of those of us who were to work on the landforms of alluvial valleys?

For meandering streams we inherited little more than a few theories conceived in two dimensions, and a terminology derived from essays on entrenched meanders. Where were the cut banks, sharpened spurs, or slipoff slopes along the Lower Missis-

sippi River? What were the proofs of swinging and sweeping? To shorten a rather long story, trying to answer such questions forced us to abandon a great deal of what we thought we knew at the start. We had to turn to students of hydrology and learn something about the characteristics of three-dimensional flow. And we had to drop a good deal of our terminology.

The cut bank of a free, alluvial meander is one of the places where effective corrasion is least likely to occur along a channel. Logs or other objects in suspension are not hurled toward it in time of flood, as one might deduce while looking at a map. During highest river stages it is a place where currents are feeble, or where they may actually be directed upstream. The retreat of cut banks is real, but it results from subsidence into pools scoured by water in turbulent flow.

The slipoff slope position of a river meander is actually an irregular upgrade across bar-and-swale corrugations of a point bar deposit. It is a complicated part of a natural levee.

A natural levee is anything but a thin and uniform strip along the side of an alluviating river. Rarely less than a mile wide along the Lower Mississippi, it widens at all point bars, and, here and there, sends long tongues of crevasse topography into adjacent backswamps. This whole complex is of greatest interest to geographers because it is ordinarily the most important site for habitations, the leading theater of agricultural activity, and the main determinant of transportation routes in the alluvial valley.

Meander belts do not swing gradually from one side to the other in a broad alluvial valley. Clay plugs form in their abandoned cut-off lakes and unused channels. These plugs are almost unerodible, and confine meander belts sharply. Diversion of a river from a well established meander belt into territory where a new belt might become established is a rare event. It has happened few times during the last several thousand years of Lower Mississippi River history, and only where fault zones have assisted the process.

The Yazoo River is certainly not a "Yazoo type" of stream. It is nothing more than an old course of the Ohio River that was left semi-abandoned by a diversion. It enters the Mississippi where the present channel happens to intersect it.

Southward, along the Gulf Coast, in the very territory where the idea of shorelines of emergence originated, we find Indian mounds that have been lowered by general subsidence at such rates as two feet per century. This subsidence has been rapid enough to keep practically all river mouths estuarine. Here our heritage from classical geomorphology consisted mainly of an erroneous group of ideas about barrier beaches and coastal lagoons, and a heavy emphasis on a tripartite subdivision of beds in deltas.

While top-set, fore-set, and bottom-set beds are conspicuous features of small deltas, such as those built in Lake Bonneville, they have practically no significance in a delta with a thickness of Quaternary deposits of about one-half mile. The primary structure is basining, related to subsidence.

The thought patterns of geologists have generally been oriented in a down-valley

direction when they have turned to flood plains and deltas. Sediments are sorted, so that finer sizes travel farthest downstream. Most geologists overlook the fact that truly sharp contrasts occur transversely. The contrast between coarse sediments in a stream channel and the fine sediments of backswamps is likely to be far sharper than that occurring down the entire length of an alluvial fill. Down in the delta, any alleged contrast between top-set and fore-set beds is a trivial matter in comparison with the sharp breaks between channel and intermediate basin conditions between distributary streams. The same generalization obtains geographically. Boundaries between contrasted forms of natural or cultural landscapes ordinarily display wide transitional belts down-valley, but are sharp and well defined between channel side and valley wall.

Classical geomorphology contributed so little toward an adequate knowledge of alluvial features that those of us who faced the question had to create an alluvial morphology of our own.

Climbing a short distance above our flood plains we came to terraces. In a vague sort of way the classical geomorphologist realized that some of these were of depositional origin, but rarely did he dig far enough into gravel deposits to become aware of their actual forms. Seldom did he examine their surfaces closely enough to find the abandoned floodplain drainage and depositional patterns that demonstrate their alluvial origin.

In tracing out the areal extent of various terraces we encountered the proposition that gravel deposits actually control denudation to an extent not sufficiently realized today.

It is obvious enough that a hill of bedrock surrounded continuously on all sides by a surface of flat, or gently sloping gravel can erode only down as far as the datum set by the gravel. It is for this reason that large areas of Tertiary bedrock in Louisiana, Mississippi, and other Gulf Coast states have been degraded toward limits set by surrounding terrace gravels. This depositional control of erosional forms must be one of the guiding principles of morphological development elsewhere. It might offer a key needed for a more rational explanation of some of the widespread bedrock surfaces in the West.

Classical geomorphology, indeed, recognized the role played by gravel deposits in originating topographic inversions, but it commonly failed to recognize some of the full consequences of the process. An extensive outcrop of readily removable bedrock may, in a brief erosional history, experience surface lowering to levels well under those of nearby gravel deposits. Several lowlands of rather unconsolidated clays and silts of the Gulf Coast region that now stand well below levels of nearby Pleistocene terraces are excellent examples of the process. One of the common, and interesting, results of this type of topographic inversion is the creation of territory where stream terraces now stand as the highest uplands, rather than as little flats within valleys. To what extent this process has operated in the Great Plains may be worth careful investigation.

Too often the student of landforms has thought of surfaces of lakes or junctions

between tributary and master streams as constituting almost exclusively the list of examples of local baselevels. Gravel flats and cones are among the more important causes of local baseleveling, but any ledge or rim of resistant rock acts in the same capacity. An extensive area may be degraded to relative flatness above the control of a local baselevel of any kind. Only gradually do geomorphologists seem to appreciate the significance of this fact, though it was recognized years ago by Daly, Tarr, and others, and is discussed whenever attention is focused on Walter Penck.

The relatively slow acceptance of periglacial processes as important geomorphological agents may serve as a final example of the way that students of landforms tend to cling to classical thought patterns, rather than to strike out in new directions so as to cover their field adequately.

Under the flats of Flanders, and across uplands extending eastward through the Campine and southeastward across the Ardennes, are unmistakable and practically universal proofs of churning and disturbances of soils and bedrock down to depths that not uncommonly exceed ten feet. Stones and superficial sands have been forced down into unconsolidated bedrock. Tertiary clays and other materials have been injected into the soil zone. This periglacial modification extends across summit flats. On slopes it is combined with effects of solifluction and other agencies of mass-movement. The dating of the latest periglacial activities is quite exact, cessation having occurred only some 10,000 years ago. Only such phenomena as the latest valley alluviation, the accumulation of the latest peat, and a general blanketing by sand of lowlands to the lee of beaches or north-south reaches of streams are younger.

Classical geomorphology found such things as upland peneplains, complicated terraces along the Meuse, and some interesting cases of stream capture in Belgium. The geographer, however, is not likely to be particularly concerned with such questions. Of more vital interest to him are the effects of periglacial activities and mass-movement, agencies that have produced a complicated mosaic in soil patterns. Also of rather direct interest are such matters as an inversion of topography caused by differential compaction of peat and sand areas in the polders, and the distribution of wind-carried sand. Here the geomorphologist can furnish the geographer with answers to his questions of what, where, and how much. Classical geomorphology failed to cover parts of the field most significant to geography.

GEOGRAPHICAL GEOMORPHOLOGY

Though geographers have many reasons for disappointment in the results of classical geomorphology, the subject should not be condemned too severely. It has served its part in the evolution of a landform science that is really necessary for a thorough understanding of places and peoples. It provided much of the basic information needed for a factual, geographical geomorphology.

Many useful geomorphological concepts come from students who do not consider themselves primarily as geographers, geologists, or geomorphologists. I refer to important contributions from foresters, pedologists, botanists, hydrologists, and

others. At the moment it may be fair to appraise the *Transactions of the American Geophysical Union* the most useful journal in the field.

In the Lower Mississippi Valley and Gulf Coast regions we are deeply indebted to the research staff of the Mississippi River Commission for a tremendous amount of factual material.

An extremely factual and useful geomorphology is being developed at present in the Low Countries in connection with soil surveys. C. H. Edelman, of the Netherlands, and R. Tavernier, of Belgium, are actively engaged in soil and landform mapping in detail such as has rarely been attempted elsewhere. Materials obtained from bore-holes drilled in a dense pattern are interpreted by agriculturalists, pedologists, sedimentologists, geologists, archeologists, paleobotanists, and other specialists. The Edelman survey employs a full-time, and extremely capable, historical geographer. *Boor en Spade,* a new journal issued by his survey, will undoubtedly become one of the best sources of exact geographical information on the Netherlands, as will the publications of the Tavernier survey on Belgium.

Thorough investigation of the effects of land use is a feature of the Low Countries' soil surveys. Settlements of Gallo-Roman times have left striking imprints on today's landscapes. Dates of forest clearing, peat exploitation, dike construction, dike breaks, shifts in road patterns, changes in general or local economy and agricultural practices, and similar matters are being studied thoroughly from the standpoint of effect upon soils and landscapes. The landforms receiving the most attention are precisely those of greatest geographical significance.

As an example of such landforms I may cite the contrasts that are commonly observed between levels of polders on opposite sides of an old dike. Some dikes were built back in Gallo-Roman times. Settlements were confined to the protected side. River floods or overflows from the North Sea continued to deposite silt and clay on the unprotected side, so that centuries later the original low and unprotected side became higher, drier, and more valuable land than the side with the original settlements. (1)

Another interesting feature of some polders is topographic inversion caused by compaction of peat. During the times of early settlement in Belgium and the Netherlands many of the streams were flowing in wide, low valleys across the coastal flats. People avoided the stream sides because they were subject to flooding. Settlements were located back on the flats, on higher areas. The flats, however, were underlain by thick beds of peat. These slowly sank as the peat layers became more and more compact. In contrast, the sand and silt along the streams resisted compaction, and retained most of its initial elevation. The low places of three thousand years ago have thus become ridges today. Some rise two or three meters above their surroundings. Occupance values changed with the topographic inversion. Cases have been found where people shifted to higher sites of settlement as early as the second century. A major shifting of populations occurred in about the twelfth century. Isn't this the kind of geomorphology that many geographers would welcome? (2)

In various parts of Belgium one of the results of periglacial activities was the forming of a complex micro-relief. Individual sandy hillocks were created with elevations commonly less than a meter high. In some districts practically all field patterns follow the outlines of this micro-relief, and agricultural practices have accentuated it. Isn't the finding of such facts a truly geographical geomorphology?

The little landforms that are being detected by the Edelman and Tavernier soil surveys are commonly so subdued that they escaped the deductions of classical geomorphology. In one place the auger reveals a slight depression marking an abandoned stream channel now filled by a meter or more of peat. In another it may reveal an old channel filled with sand. A tiny elevation may mark a place where a mass of Tertiary clay has been injected into Quaternary silt. Each of these little landforms has its own characteristics in regard to stability for foundations, occupance values, or crop production. Test plots commonly reveal as much as one-third difference in crop yields on contrasted soil types spaced only a few meters apart horizontally and a few centimeters vertically. Could geographers blind to these slight contrasts in landforms really understand the cultural landscapes of the Low Countries?

I believe that those of you who were members of the field excursion party in Louisiana in 1940 will agree that it would be difficult for geographers to do serious research in the flat lowlands of the Gulf Coast without a rather adequate knowledge of alluvial morphology.

My emphasis on alluvial and lowland features is not intended to convey an impression that I regard a true geographical geomorphology as the investigation of nearly flat surfaces. It has arisen out of my own limitations in experience. I have had the good fortune of being associated with people who have gotten down to brass tacks and discovered new and interesting things about lowlands. I have no doubt that equally interesting results are coming from the uplands. What I seriously advocate is the development of a factual study of landforms that cuts away from classical patterns where evidence so demands. When geomorphology really tells us what is present in a landscape and tells us exacly where each form is to be found, it becomes geographical.

APPLICATION

During my recent stay in northwestern Europe I could not escape the conclusion that the position of geographers generally is not one of high esteem. I found the field criticized sharply on all sides. Most of the criticism related to a tendency for geographers to attempt research in fields they had insufficient background to enter. One critic flatly denied that geography is a field of knowledge at all, for the reason that it offers nothing unique which may be regarded as its own peculiar technique or method. He denied an appeal to cartographic expression as stoutly as he denied the proposition that all things printed in words belong to the field of literature. He claimed that our techniques are really those of the mathematician, historian, economist, demographer, geologist, engineer, or other specialist, according to the

demands of the problem under consideration. He denied flatly that geograhers have powers of synthesis that differ from those employed in other disciplines, or special license to stray into the domain of others. My abilities in debate were taxed severely at times.

My own feeling has never been one of great concern about such questions. I have always regarded myself as a geographer whether others thought so or not. I have felt that the survival of geography as a field depends on what we do, rather than on how well we debate.

To me, geography is essentially the study of places, and of peoples because they have so much to do with modifying places. From this core I visualize our field as radiating in all directions, and for various distances, toward the cores of other disciplines. Questions of boundaries always seem pedantic in comparison with questions concerning the cores of disciplines.

Whether geomorphology belongs to geography or geology seems to be a question unworthy of the debate it has occasioned. Classical geomorphology was chiefly geological, yet it developed many ideas useful to geographers. I feel somewhat happy when I notice attempts of either geographers or geologists to claim the subject, and somewhat dejected when I see either trying to pass it over to the other.

The broader, generalized geography,—the recognition of major cultural and natural landscapes of continents and islands,—required such syntheses of geomorphological research as have been undertaken by Atwood, Bowman, Fenneman, Joerg, and others. A more detailed geography appears to demand a geographical geomorphology of a more factual variety.

I believe that our Association can strengthen itself, and improve the position of geography generally, by admitting freely to its membership the individuals who develop a sound, geographical geomorphology. I hope that we can stimulate them to take an active part in our programs, and that we publish many of their studies in the *Annals*.

I think that it would be unwise for individuals already advanced along other directions to give too much attention to the possibilities of inclining their work in geomorphological directions. Each of us had better strike out in the direction he is best prepared to follow. The greatest danger to the position of geography arises if too many of us set sights on points on or beyond the boundaries of fields claimed by others. The core of geography may be left in a rather nebulous state. To strengthen the field of our major interest it is necessary that a considerable number of individuals follow lines of investigation that converge toward the core of geography.

Convergence toward the core suggests research with a somewhat earthy flavor. Such research will both develop and depend heavily upon a true geographical geomorphology.

ON THE CLIMATIC DESCRIPTION OF PHYSIOGRAPHIC REGIONS

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INTRODUCTION

A CLIMATIC map, especially one on a continental or regional scale, is at best an approximation to the truth. Mapping of climatic data is complicated by variations occurring within a given locality, which may be as great or greater than the larger scale variations over a region or even over a continent. A further limit to accuracy is set by the density of the station network, which with minor exceptions is not great enough to establish details of the pattern.

The climatic aspects of regional geography involve the relationships between natural and cultural features of the region and its climate; but when the climate is investigated on a small scale, a strong connection becomes evident between it and the associated topography, a connection which must be partly described in terms of an effect of elevation and partly by more complex effects such as variations in insolation. The existence of the dependency on topography is hardly surprising when the entire temperature difference from equator to poles is found within six miles of vertical distance, and when marked differences of physical condition exist between windward and leeward slopes, and between northern and southern exposures.

These local climatic features, related as they are to the topography, occur on too small a scale to be shown on a regional map; hence the regional climatic map usually shows only broad, general features of the climate. The process of approximation by which the map is arrived at may suppress local patterns as significant as the grosser ones that it reveals. Unless this fact is appreciated, the map is open to misinterpretation when an attempt is made to use it for regional study.

The purpose of this paper is to investigate more or less analytically the approximative processes by which a climatic map is constructed in order to reveal how these approximations are influenced by the physiography of various regions. Methods will be suggested for formalizing certain of these processes so as to increase the usefulness of the resulting map for regional geographic uses.

ANALYTIC RELATION OF CLIMATIC ELEMENTS TO TOPOGRAPHY

It will be assumed that all the major climatic elements may be considered as single-valued functions continuously distributed on a topographic surface, called the surface of observation. This assumption is warranted for elements such as pressure and temperature and is a sufficiently good approximation with regard to others. The discussion will also be limited to the climate of the earth's surface and will not include the climate of the free air.

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The elementary unit of any climatographic system is an individual observing station and its data. At best, observations at any station represent only conditions within a very short distance of it; within the limits of an observatory site itself, the wind at the anemometer level may be twice that at the rain gauge, and the temperature in the thermometer shelter may be five degrees higher than that of the grass growing beneath it. These microclimatic aspects have been studied as a subject in themselves. While not of direct concern to the problem at hand, they accentuate the fact that the "climate at a station" refers only to a specific set of observational circumstances and only approximates the climate of the immediate vicinity. The size of the area for which a station may be considered representative depends upon the physiography of the region and also upon practical considerations governing the breadth of tolerance in representation.

In passing from the climatic description of a single place to the description of a region, each station is necessarily considered in some degree representative of the area between it and the adjacent stations. Information about the intervening area must be obtained by interpolation between nearby stations. Because of the open character of the climatographic network this interpolation must be guided by the climatographer's skill, his knowledge of systematic variations in the local climate, and practical matters of how the map is to be used.

The strongest systematic dependence of climate on physiography is its relation to elevation, but even this varies from one region to another. Because of the other local influences it has meaning only as an average, which should be determined for each region from as large a body of data as possible. Despite well-known variations, a world-wide average value is still generally used in reducing such an important element as temperature to a sea-level datum plane.

Once the mean vertical gradient of a climatic element is evaluated over a region the climatic data for each station may be reduced to a horizontal datum plane, usually sea level, and a map of the horizontal gradients of the element may be drawn. Although the average effect of elevation is thus eliminated, the isopleths still should not be drawn without regard to the physiography, since local physiographic influences on the climate are significantly effective. The interpolation, as before, must be based on the personal competence of the climatographer, since enough data to describe all the individual effects are almost never at hand. The value of the element for any point on the topographic surface may be found from the resulting map by applying the appropriate altitude correction; if the reduction and interpolation are correct, the result will be appropriate to a small area about the point, but not necessarily to the point itself. The cruder the interpolation, the less discriminating becomes the area.

A map reduced to a datum plane is a useful way of presenting general climatic features that would be obscured by the complexity of the actual distribution of elements. The disadvantage of such a map is that it does not represent a real situation and has meaning only in conjunction with a topographic map.

In presenting the large scale distribution of unreduced climatic elements, the effect of topography is all too often neglected and a wholly artificial pattern drawn.

In more careful work, the actual topography is ordinarily approximated by a simplified one of such diminished complexity that it can be represented on the scale of the finished map. This process may be more or less subjective and unconscious. The climatic element is then mapped on this simplified topographic surface. It is obvious, however, that the resulting map will be no more accurate than the topographic approximation on which it was based, nor can the user estimate the degree of its accuracy unless he has that topographic map before him. Therefore such a map is of limited usefulness for regional geography, although it affords perhaps a satisfactory way of presenting large scale climatic features. If the actual climatic distributions are to be shown, if small scale differences of the same order of magnitude as large scale ones are to be presented, the map must be on a scale large enough to show all significant features, every hill and forest. Such a scale is not practicable for a map covering an area as large as a physiographic region.

An examination of the characteristics of various types of physiographic region suggests that some topographic approximations may be more useful to the geographer than others, especially in the study of specific topics. For example, in the different stages of dissection of a plateau, different topographic levels may have major significance. In the early stages the plateau surface would contain most of the cultural and geographic features of significance and the narrow stream courses would be relatively unimportant; while in the late stages, when stream valleys had spread to include most of the area, these valleys would define the significant surface and the remnants of upland slopes would lose importance. Thus by careful selection of the topographic level best adapted to the geographical and cultural features under consideration, a representation of the climatic features related to them can be obtained which is superior to what would be got on the basis of simple averaging. As an example of the selection of a topographic surface significant to a specific topic, the surface defined by the levels of major stream courses will be referred to in a later paragraph.

CLIMATIC SURFACES OF REFERENCE AND LOCAL CLIMATIC IRREGULARITIES IN RELATION TO PHYSIOGRAPHY

The least irregularity in the pattern of climatic elements will be found, in general, where the terrain is flattest and most featureless. The flattest physiographic region is therefore the least complex climatographically. However, it is known that a ground slope of as little as one in two hundred has a very significant microclimatic effect, creating spots of cold climate through drainage of nocturnally cooled air and bringing about marked ecological contrasts.[1] Furthermore, surface cover and surface roughness often find expression in the local climate. The precise nature of these effects is not important here except to note that many climatic elements will exhibit a significant range of values, caused by topography, even over a region where the surface itself is almost flat. On a regional map, the topography can be represented with almost absolute accuracy, so that no formal approximative method need

[1] R. Geiger, *The Climate Near the Ground,* translation by the Blue Hill Observatory, Milton, Mass. (In Press).

be applied; the residual irregularity of the climatic elements appears as characteristic of these elements.

In the case of mature coastal plains and piedmont plains where subsequent drainage has developed vales and downs, and to a somewhat lesser extent for any plain having low but noticeable relief, local climatic irregularities bear a systematic relationship to the drainage patterns. This is because the relatively flat topography does not cause rain shadow, down-slope winds, marked variations in insolation, or other secondary orographic effects. The actual topographic surface may be simple enough so that it can be adequately mapped and used as a climatic surface of reference; in portions of the map where this is not possible, as for instance along the crest lines of downs where small obsequent drainage features cut the crests, care should be taken to have the topographic reference surface follow the more important physical surface.

Peneplain patterns will, in general, be less systematic than those of coastal plains, and the topographic surface of reference will necessarily be more boldly averaged over the surface of the plain except where regularity of the underlying geologic structure is revealed in the form of vales and hogbacks. The courses of consequent streams and the divide lines between them will in most cases adequately define the topographic reference surface. Monadnocks and residual areas of relief must be given special attention depending upon their relationship to the geographic values under study; in most cases they are not of more than local importance to the general geographic pattern, but they may be quite important in considering rainfall and water supply.

Other types of plain, such as structural and glacial plains, tundra, loess, erg, etc., are not greatly different in their climatographic characteristics from those already discussed.

Plateaus, on the other hand, show important climatographic characteristics, depending in magnitude upon the degree of erosional dissection and the amount of relief. A completely undissected plateau is, of course, climatographically a plain; however, when erosion develops to the point where the interfluves no longer represent the dominant characteristic of the region and the effect of hillside and floodplain surfaces must be taken into account, the situation becomes greatly complicated. The degree of relief contributes significantly to the irregularity of the climatic elements by reason of differences of elevation, and the slopes are steep enough to produce marked local effects due to insolational differences. Except in the most extreme cases, however, orographic influences and rain shadow are ineffective.

Thus for a plateau region there are two principal topographic reference surfaces, that of the plateau surface itself, and that defined by the floor level of the streams. The actual distribution of elements is further locally influenced by patterns of interfluve, slope, and valley. Since contrasts in the cultural features of a plateau usually correspond to physiographical contrasts, it may be desirable to map the climate for each surface independently, to choose one or the other, or to compromise

with an intermediate surface, depending on circumstances. In the lower Kweichow Plateau of southern China the floodplains, though narrow, encompass the greater portion of the culture of the countryside and form the topographic reference surface of primary importance; on the dissected diluvial benches of eastern Italy, the situation is radically different, for most often towns are situated on the summits of hills to avoid the malaria-bearing mosquitoes, and most agriculture is on the nearby slopes. The Appalachian Plateau in western Pennsylvania, on the other hand, cannot be described in terms of a single surface of reference, since the dissection is deep and cultural features of importance are found at all levels.

Let us consider next those regions of disordered structure whose relief does not warrant the appellation of mountains but which are neither plains nor plateaus. Geologic shields, incomplete peneplains, lopoliths, and low dome structures are typical of this class of regions. In climatographic complexity they are intermediate between the peneplain and the dissected plateau; local topographic features find significant climatic expression, yet no single topographic surface can be defined which is dominant unless by reason of some cultural peculiarity of the region or for some specialized purpose. On the other hand, climatic irregularities are more systematically dependent on altitude than is true of plateaus or mountains, since slopes are generally less steep, valleys broader, and ridges rounder than for those. A topographic reference surface following the principal water courses and divides will serve most purposes when the further dependence of the climate on local elevation is kept in mind by the geographer.

It may be worth noting that some of the principal industrial complexes of the world are located in regions of disordered structure and low relief, which are likely to contain mineral deposits, water power, and other resources favorable to industry. This is true of the Ruhr-Saar region, the English Midlands, the Donets Basin and the southern Urals, and to some extent of Manchuria. The industrial activity is nearly always concentrated near the stream floor, where water power and water transportation are most easily available. The principal watercourses should then be given added weight in constructing the topographic reference surface. This is likewise true for regions that have not reached cultural maturity, since colonization generally follows the major valley lines. For example, a cultural map of New England still reveals the strong influence of the Connecticut and Merrimac Valleys in channeling colonization of the interior; the upper Connecticut valley was farmed for a century before the passes through the White Mountains were traveled or the upper intervales settled.

True mountains, whether folded, faulted, or intrusive in origin, present the greatest contrasts of climatic elements and the greatest difficulty in mapping these elements adequately. Both the direct effects of elevation and its indirect orographic effects are present there in complex array. In many instances it may be possible to define accordant grade and summit levels, particularly in the case of folded mountains and those developed by deep erosion of a peneplain, but this is by no means generally true, and the climatography is therefore most inaccurate and

unspecific. Rain-shadows of individual mountain ranges throw their influence over major portions of a region, and up- and down-slope winds develop more than local importance. A single peak often extends vertically through climatic bands which normally spread over thousands of miles of latitude; Mont Blanc has its feet in a Mediterranean climate, its slopes are covered by snow-forest vegetation, and its upper portions penetrate an arctic climate, while its glaciers thrust fingers of perpetual ice far down into the forest zone. Here it is obvious that the climatographer must resort either to broad generalization or else to specialized description.

SUGGESTED CLIMATOGRAPHIC PROCEDURES

On the basis of the characteristics of regions, described in the previous paragraph, some definite climatographic procedures can be proposed.

The first proposal is that the actual topographic surface of the earth be replaced for climatographic purposes by a topographic surface of reference selected on some relatively formal basis consistent with the nature of the region and the geographical purposes to be served. This topographic representation should preferably be made a part of the climatic map or attached to it; in any event, its formal basis should be stated so that the geographer will know how the climatography was arrived at.

Secondly, it must be recognized that when local values are smoothed, even on the most featureless plain, there is interpenetration of different values of the climatic elements. In some regions the degree of interpenetration is far more important than in others, and the degree and nature of this interpenetration is dictated by the physiography of the region. A regional climatographic map should show the degree of representativeness as well as the generalized distribution of climate over the region.

A logical method of showing the representativeness is to sub-divide the map into areas the size of the smallest feature that can practicably be shown, and then to indicate for each such sub-region the extreme values of the climatic element within it. Drawing isopleths of the extremes as well as of the means completes the map. This method is particularly applicable to regions which can be adequately represented by a single topographic surface of reference; its applicability to plateaus and areas of strong relief depends on the range of variations which would have meaning for a given situation.

When a combined climatic element, such as a climatic type according to the Köppen classification, is to be represented, interpenetration of climatic types can be shown simply as overlapping of the climatic regions, carrying the boundaries of each region outward to include the entire area within which the type is found in significant local quantities. This procedure would greatly improve certain features of the present Köppen map by showing, for instance, that Asheville, North Carolina, does not have hot summers and that Lhasa is not built on ice.

A third method suggests itself through the observed systematic dependence of the climate on elevation; this is to map the topography of a fictitious surface over

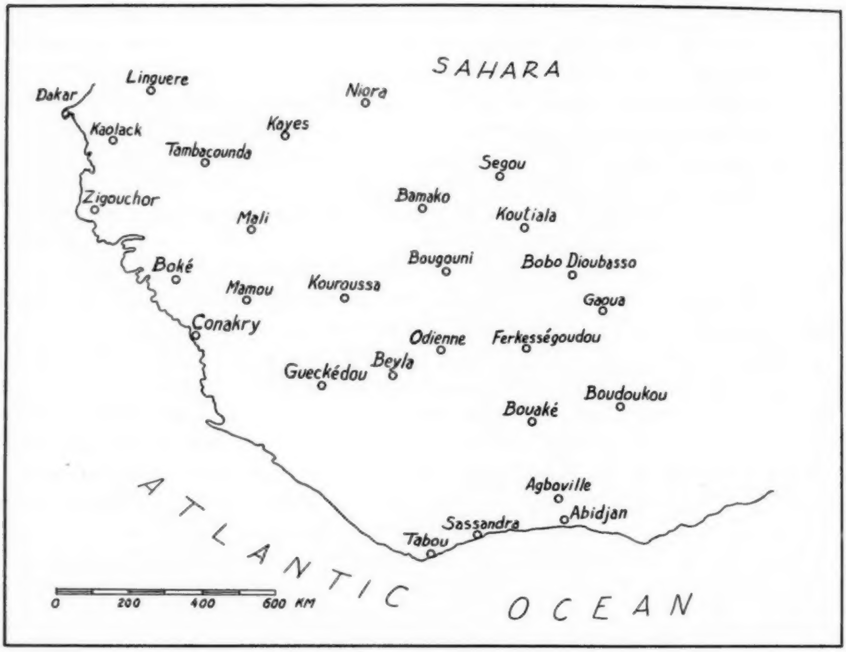

FIG. 1. Key map of reporting stations used in Figures 6 and 7.

which the value of the climatic element is constant. This is quite analogous to the use of constant-pressure charts for synoptic meteorology instead of constant-level charts, a procedure which has found much merit in that field. Such a chart would present much the same type of information as the map of the element reduced to a sea level datum plane, but would permit selection of the value of the element most nearly consonant with the surface of the region rather than to some arbitrary level. Moreover, it would present, at least at the intersections between the fictitious surface and the ground, a real rather than a fictitious distribution. The chart could be supplemented by cross sections showing the profiles of several surfaces.

APPLICATION TO A SELECTED REGION

As a demonstration of the principles evolved in the preceding sections, an attempt will now be made to apply them to the description of a physiographic region of West Africa. The region selected is that of the Guinea highlands, extending in a broad U from the Fouta Djalon plateau of French Guinea to the headwaters of the Volta Noire. The climatic element selected for the demonstration is temperature, since it is of great importance to the description of the region and serves well the purposes of the demonstration. The stations from which temperature data were obtained are shown in Figure 1.

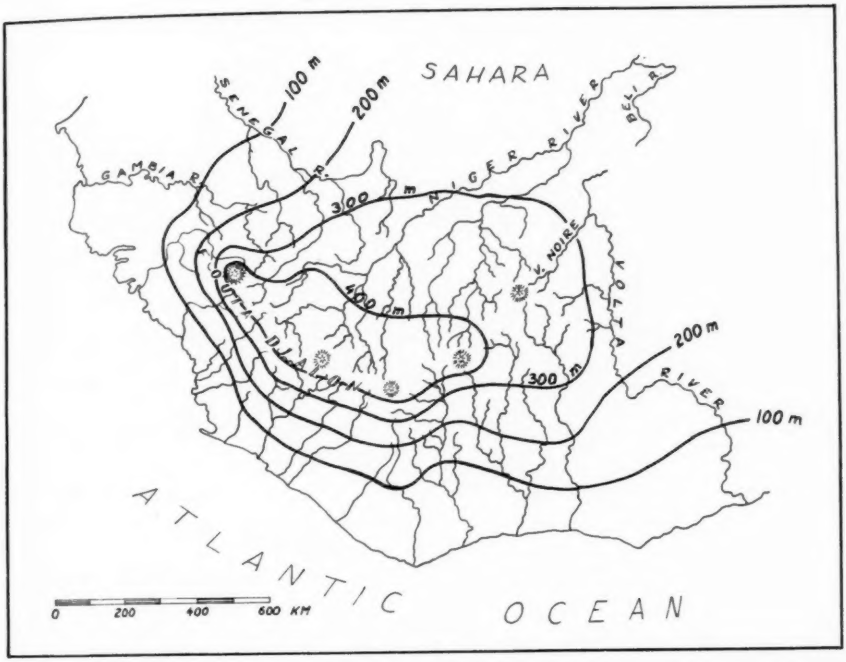

FIG. 2. The Guinea highlands of West Africa, showing the drainage systems, the five principal domes of the highlands, and approximate elevation in meters of the principal stream beds.

The Guinea highland, composed of Archaean rocks, represents an upwarped portion of the great African geologic shield. It overlooks to the north the broad basin of the western Sahara and to the south a narrow piedmont, with a strip of coastal plain on the southeast, separating it from the continental shelf. Because of its prominence and the high rainfall of the region, active erosion is in progress.

The structure of the region is disordered, and the adjustment of drainage to structure is progressing actively. Along the backbone of the region, five well-marked domes may be traced by the indications of radiating streams rising on their sides, as is shown in Figure 2. As far as the outer flanks of the region, stream flow is predominantly of a consequent type, although complex histories of stream piracy have led to dendritic patterns and greatly assisted the lowering of stream beds well into the heart of the region. All the principal consequent streams and many of their tributaries are thus deeply entrenched throughout the greater portion of their courses, particularly on the south side of the region where the sea provides an immediate base level. Along the divides connecting the principal domes, the coastal streams with their lower base level have in many places lowered the divides and pushed them northward, so that numerous passes through the highlands have been

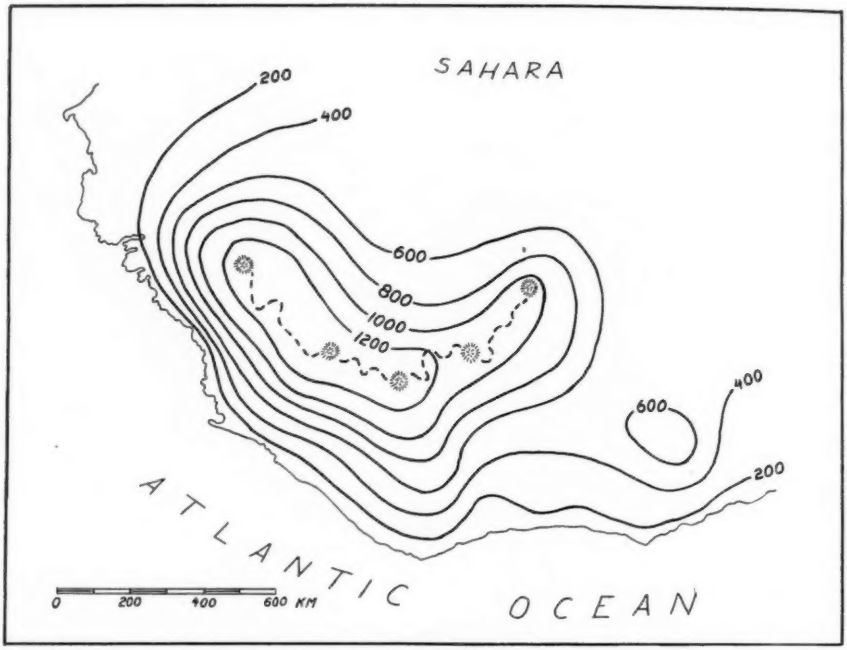

FIG. 3. The approximate elevation in meters of the interfluve surfaces in the Guinea highlands, and the principal drainage divide.

brought into being. Along the northern border of the region, widening straths border the larger streams between the spurs of hilly ground. The interfluves and domes are for the most part gently rounded.

The character of the region permits its description in terms of two principal topographic surfaces, the first defined by the drainage beds of the consequent streams, and the second by the interfluvial divide and ridge lines. These surfaces are shown in figures 2 and 3 respectively. They bear a distinct relationship to the culture of the different parts of the region. On the south slope of the highland, the vegetation is principally tropical rain forest which occupies valley floors and mountain sides alike; the principal agricultural areas therefore are in the valleys and on the lower mountain slopes where access is easiest. In the heart of the highland the interfluve surface provides the best line of communication by its avoidance of stream crossings and therefore represents a more important level in that area. On the northern slope, the highest ground has a favorable enough balance of precipitation over evaporation so that forest growth remains, but most of the upland is park savanna, with sparse woodland along stream beds. Throughout the region, altitude affords the only relief available from the tropical heat.

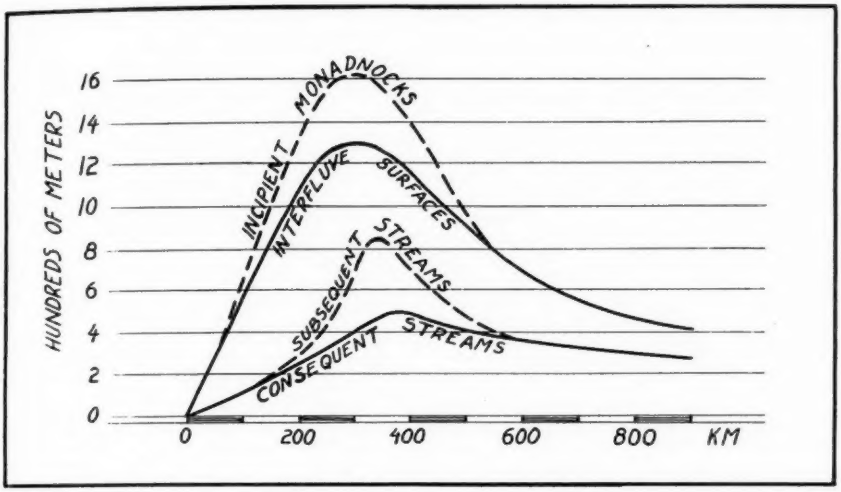

FIG. 4. Typical cross section of the Guinea highlands.

In addition to the stream-bed contours, the drainage system of the region is shown on figure 2, and also the position of the five principal domes. The contours show clearly the relatively steeper gradient of the seaward slope. Also evident is the strong headward advance of the Volta River which has advanced its headwaters across the divide to pirate a tributary from the Niger by capturing the Volta Noire from the now decapitated Beli River. The broadest development of the stream-bed surface must be inferred where its slope is least, the streams most mature, and the valleys hence most widely planed; this surface is least representative near the head-water divides and on the steep Atlantic scarp, where the valleys retain their V shape. Figure 4 shows a typical cross section across the divide, the solid lines being the intersections of the surfaces mapped in Figures 2 and 3, and the dashed lines the most important non-conforming levels, incipient monadnocks and subsequent drainage beds. The contours and cross section are at best only approximate, since only scattered levels are available in the region and many of these are at points intermediate between stream beds and interfluves.

The contours of the interfluve surfaces, shown in figure 3, are based on even scantier data; but, although far from accurate, they serve to illustrate important characteristics of the region. Particularly along the divide, many incipient monad-nocks reach to altitudes above 1500 meters, but the area of land above that level is insignificant. It is seen that the contrast in elevation between the stream-bed and interfluve surface is much greater on the seaward slope than on the inland slope. The upland surfaces on the north shade more regularly into low hilly spurs than is the case on the Atlantic side, where V-shaped valleys extend farther from the divide and terminate more abruptly.

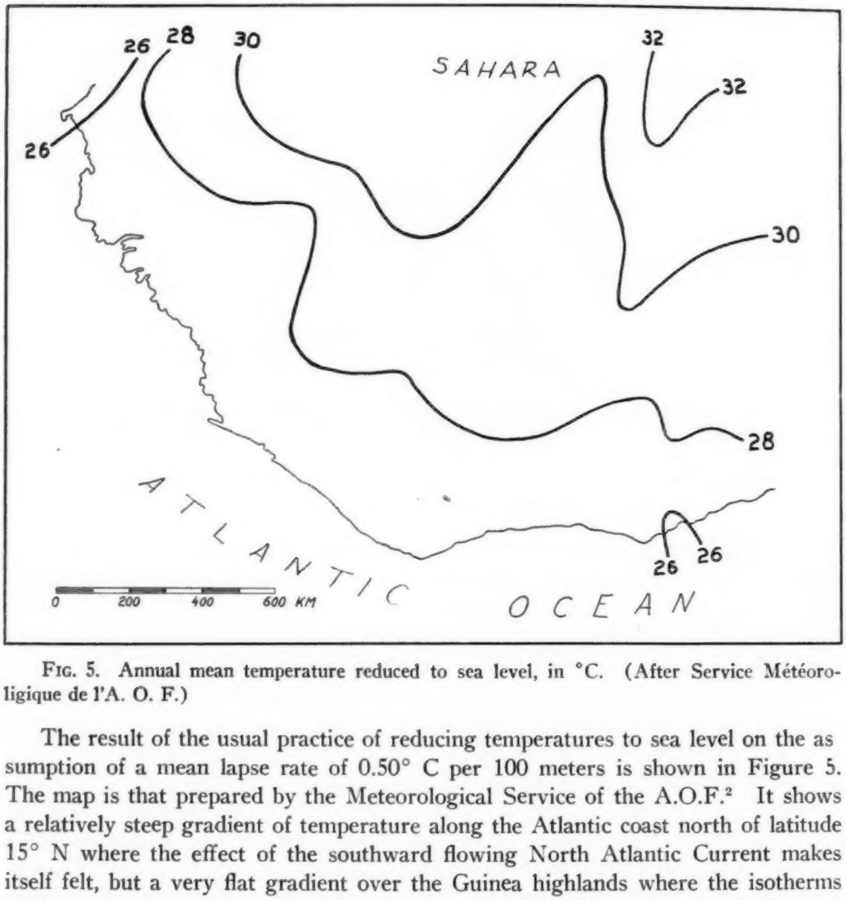

FIG. 5. Annual mean temperature reduced to sea level, in °C. (After Service Météoroligique de l'A. O. F.)

The result of the usual practice of reducing temperatures to sea level on the as sumption of a mean lapse rate of 0.50° C per 100 meters is shown in Figure 5. The map is that prepared by the Meteorological Service of the A.O.F.[2] It shows a relatively steep gradient of temperature along the Atlantic coast north of latitude 15° N where the effect of the southward flowing North Atlantic Current makes itself felt, but a very flat gradient over the Guinea highlands where the isotherms wander in an erratic fashion. The impression gained from this map is that the temperature over the region is determined principally by interaction between oceanic and continental controls. Coastward extensions of high mean temperature are barely apparent to the north and southeast of the highland.

The actual facts are quite otherwise, for it is altitude that exerts primary control upon the temperature of the region. This is brought out clearly by Figures 6 and 7, which show the mean temperature reduced respectively to the stream-bed and interfluve surfaces. In contrast to the fictitious distribution of sea-level mean temperature, the highland constitutes a zone of cooler weather, even at the lowest ground levels. Furthermore, it influences the flow of the prevailing northeasterly

[2] *Memento du Service Météorologique*, No. 7-A, Moyens, et No. 7-C Cartes des Moyens, Grande Imprimerie Africaine, Dakar, 1942, 138 & 102 pp.

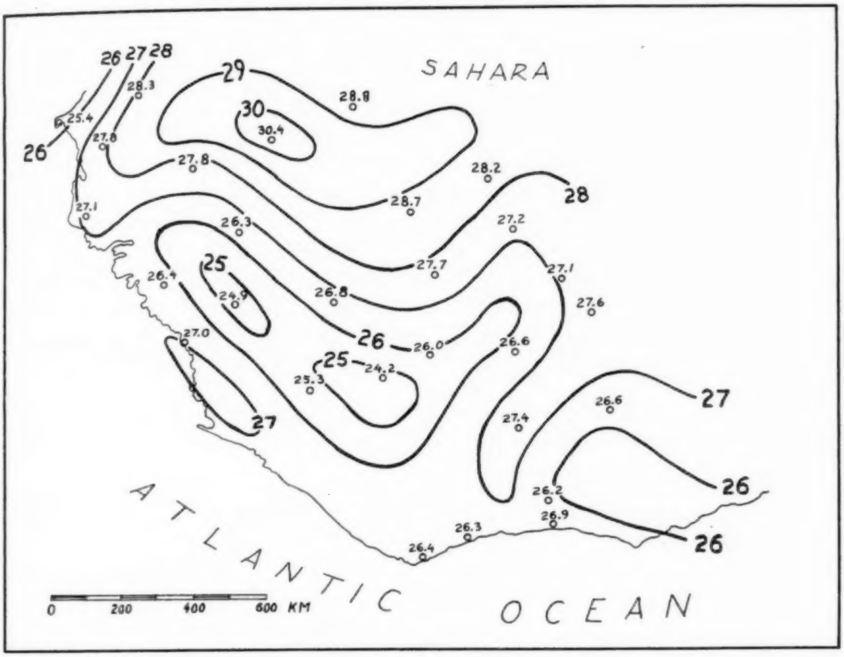

FIG. 6. Annual mean temperature reduced to stream-bed surface, in °C.

winds of the dry season, apparently damming it to some extent. Distinct tongues of high temperature extend around the northeastern side of the Fouta Djalon and through the low gateway of the northeastern Ivory Coast Colony. A region of high temperature along the coast southeast of Conakry may likewise be attributed to descent of continental tropical air through a gap beween two of the major domes of the highland.

The actual temperature gradient between the southern Sahara and the highlands is, of course, much steeper than that indicated by the sea-level mean temperatures and shows clearly that rainfall over the highland area, besides being heavier because of the greater proximity to the coast, experiences a much higher precipitation effectiveness ratio,[3] the PE ratio increasing from 40 at Kayes to 138 at Mamou on the stream-bed surface. The climate of the interfluve surface diverges particularly sharply from that described by the sea-level mean isotherms, with a distinct cool zone along the crest of the highlands. On the upper part of the Fouta Djalon plateau the precipitation effectiveness increases to a value of 162, nearly four times that of Kayes.

Comparison between Figures 6 and 7 shows further the climatic relationship

[3] C. W. Thornthwaite, "The Climates of North America According to a New Classification," *Geographical Review*, *XXI*, 633–655.

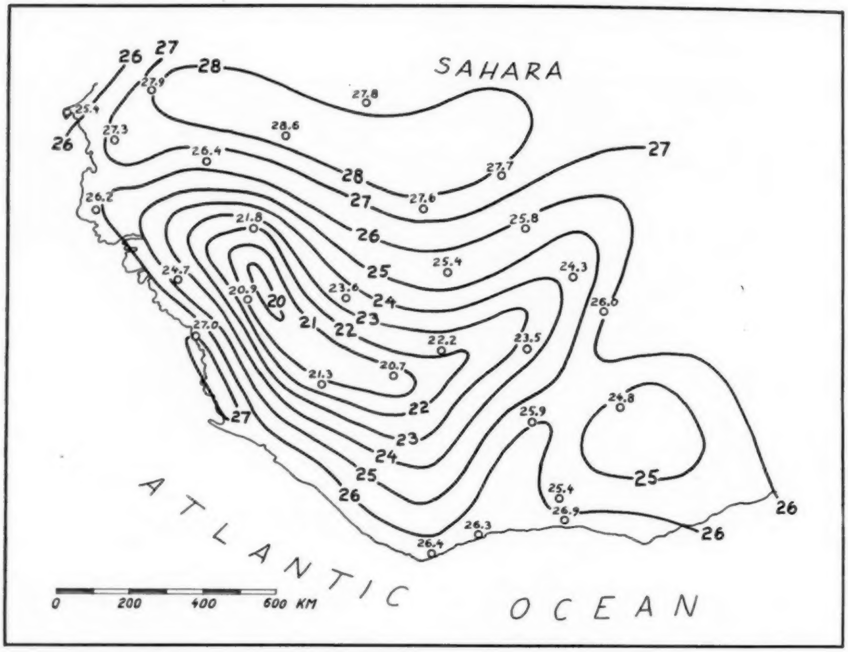

FIG. 7. Annual mean temperature reduced to the interfluvial surface, in °C.

between the valley floors and the interfluve surfaces. Temperature and rainfall effectiveness become favorable in a more steeply rising curve for the interfluvial surfaces than for the river beds, thus indicating that highland spurs along the upper Senegal and Niger reaches will have a distinctly more favorable climate than the river bottoms, barring the effect of works of man such as irrigation projects in supplementing the bounties of nature.

Unfortunately the region under consideration does not permit representation of interpenetrating climatic regions according to the Köppen classification, since the entire area lies within the *A*-type climate, and is subdivided only by the change from *Af* to *Aw*. Since this transition is defined only in terms of seasonal distribution of rainfall, and this is not affected by the differences in altitude between neighboring points, the interpenetration in this case cannot be represented.

In conclusion, it may be stated that mapping of annual mean temperatures on formalized topographical surfaces selected to represent significant portions of the actual land surface enables the climatologist to represent actual relationships of the climate as affected by the temperature with a much greater degree of reasonableness and in a fashion much more easily understandable to the geographer than is possible either through the use of mean temperatures reduced to sea level or of these temperatures reduced to an average unspecified topographic surface.

SUMMARY

It has been shown that the average climatic chart, being based upon a topographic approximation to the true ground surface, is no more accurate than that approximation and cannot be adequately interpreted without it. Methods have been suggested for formalizing the approximative processes so as to reveal the most significant characteristics of the actual climatic distributions. These methods may be applied with benefit wherever a climatic element is affected by topography, even in areas of low relief.

Applying this procedure to the description of the mean temperature of the Guinea highlands of West Africa, maps have been constructed which show the distribution of mean temperature in a fashion which gives it more meaning for the geographer.

THE CLIMATES OF TURKEY ACCORDING TO THORNTHWAITE'S CLASSIFICATIONS*

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University of Istanbul

INTRODUCTION

TURKEY is situated between latitudes 36° N and 42° N and presents a large land area near the center of the land masses of the Old World. From the climatic point of view, high and irregular relief of the mountain ranges, extensive highlands at various altitudes, and steep-sided intramontane depressions are the most important characteristics of the country's physical features. A comparison between a physical map and a rainfall map, e.g., makes clear that relief plays an important part in causing differences in the amount of rainfall throughout the country. The direction of the high marginal ranges (Pontic Mountains, Taurus Mountains) is west-east. Thus, the mountain ridges lie across the direction of the rain-bearing winds. This arrangement produces an exaggerated rain-shadow effect on the lee sides of the ranges. In general, the country is subject throughout to the influences of the surrounding land and water masses, the subtropical high pressure area over the Northern Atlantic, and the cyclonic disturbances coming from this ocean especially during the winter period. Yet the effectiveness of these influences varies from season to season and from on region to another.

According to the prevailing influence the following four chief climatic types can be distinguished:

(1) The Mediterranean (in the south and west) with hot, dry summers and mild, wet winters.

(2) The Pontic (in the north) with warm summers, mild winters and sufficient precipitation at all seasons.

(3) The Sub-Continental (in the northeast) with fairly warm summers, but very cold winters, and sufficient precipitation at all seasons.

(4) The Semiarid (in the interior and southeast) with cold winters and hot, dry summers.

But such simple distinction fails to recognize and to localize the marked differences which actually exist between the regions in rainfall totals, in seasonal distribution of precipitation, and in temperature regimes. There are sharp climatic contrasts even in various locations below 1200 meters which are the most populous and, from the agricultural standpoint, most important parts of the country. A more detailed classification of Turkey's climates, therefore, is very desirable and is particularly significant to successful land utilization. In spite of this, no special attempt

* This contribution is sponsored for publication by C. Warren Thornthwaite of the Johns Hopkins University.

at a regional and detailed division of the climates of Turkey according to any certain classification has previously been made except that of Christiansen-Weniger[1] on the basis of Köppen's system. The results of this attempt were unsatisfactory because climatic data were insufficient at that time and because relief features were not adequately considered.

Nevertheless, if the Köppen system were now used more precisely, the resulting map would indicate, apart from the cold climates of high mountains, all the coastal parts of the country and by far the greater part of Thrace as Csa, the northeastern corner of the Black Sea as Cfa, the interior as BSs, and some transitional regions as Dfb or Cfb. Yet there are sharp climatic differences within each of these areas which may be discerned in the statistics presented in Table I.

TABLE I

Station and altitude (m)		Mean temperatures (C°)			Average rainfall totals (mm)	Designation	
		Coldest month	Warmest month	Year		after W. Köppen	after Thornthwaite (1931)
Dörtyol	(70)	10.7	28.1	19.7	1081.9	Csa	BB′ra
Antalya	(47)	9.9	28.1	18.5	1051.7	Csa	BB′sb
İzmir	(3)	8.3	27.7	17.4	639.9	Csa	CB′sb
Muğla	(648)	5.2	26.1	15.0	1443.5	Csa	AB′sb
Rize	(65)	6.9	22.6	14.7	2493.1	Cfa	AB′rb
Giresun	(21)	6.6	23.4	14.5	1402.6	Cfa	BB′rb

Since Köppen's classification could not be used to indicate the local differences between the climates of various regions of Turkey, Dr. C. W. Thornthwaite's system, as described by him in his paper of 1931,[2] has been adopted here. The PE indices were established by means of a nomogram based on the following formula:[3]

$$PE = \sum_{n=1}^{12} 1.65\, P/(T + 12.2)^{10/9}$$

where P is the monthly precipitation in millimeters and T the monthly average temperature in degrees centigrade. The TE indices were calculated by means of the Thornthwaite formula[4] converted into centigrade degrees.

$$TE = 5.4T° \ C.$$

In this way, PE and TE indices have been obtained for fifty-three meteorological stations (Fig. 1) for which rainfall and temperature records are available. But there are a number of locations for which only rainfall data exist. In such cases

[1] F. Christiansen-Weniger, *Die Grundlagen des türkischen Ackerbaus* (Leipzig, 1934).

[2] C. W. Thornthwaite, "The Climates of North America According to a New Classification," *Geographical Review, XXI* (1931), 633–655.

[3] J. Setzer, "A new formula for precipitation effectiveness," *Geographical Review,* XXXVI (1946), 249.

[4] *Ibid.* 262.

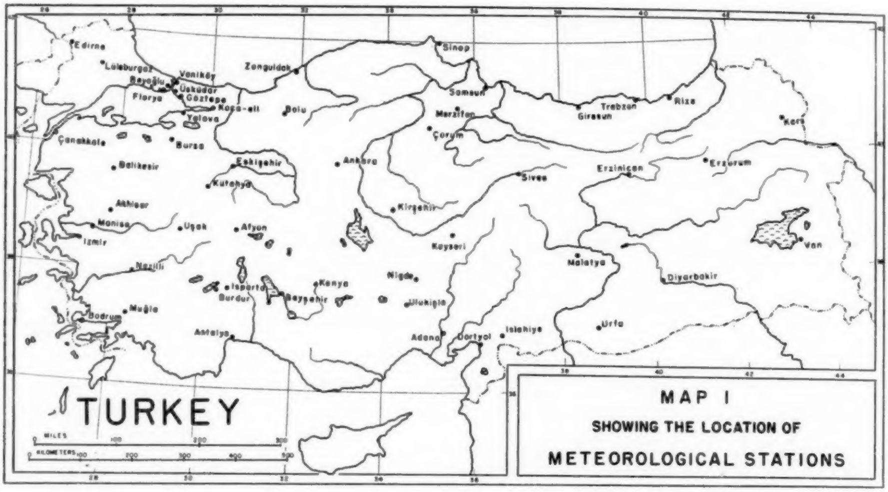

FIG. 1.

the temperatures have been estimated from known records.[5] The results of the calculations are given in Appendix I. The climatic map (Fig. 2) is based upon these calculations.

As the attempt to classify the climates of Turkey according to Thornthwaite's original classification was completed, Thornthwaite's new paper,[6] in which he develops his new system, was received. Thus, it became necessary to expand this paper to include also an attempt on the new basis, at least insofar as the chief groups were concerned. The potential evapotranspiration was obtained by the same means as described in Thornthwaite's last paper. The old PE indices were then converted into new moisture indices by means of the formula:

$$\mathrm{PE} = 0.8\,\mathrm{I} + 48$$

given in the same paper. Thus the chief climatic types according to new classification were obtained.[7]

In what follows, an analysis of Turkey's climates according to the original classification is given in Part I and that according to new system is treated in Part II. It appears desirable to include the classification according to the original system

[5] All of the temperature and rainfall records were obtained from U. E. Çölaşan, *Türkiye İklim Rehberi* (Ankara, 1946).

[6] C. W. Thornthwaite, "An Approach Toward a Rational Classification of Climate," *Geographical Review*, XXXVIII (1948), 55–94.

[7] NOTE BY C. WARREN THORNTHWAITE: These are not really the climatic types according to the new classification, but rather the old types using the new notation. To obtain the new types it is necessary to make new computations. I should like to see the moisture regions of Turkey determined by both systems and the two compared.

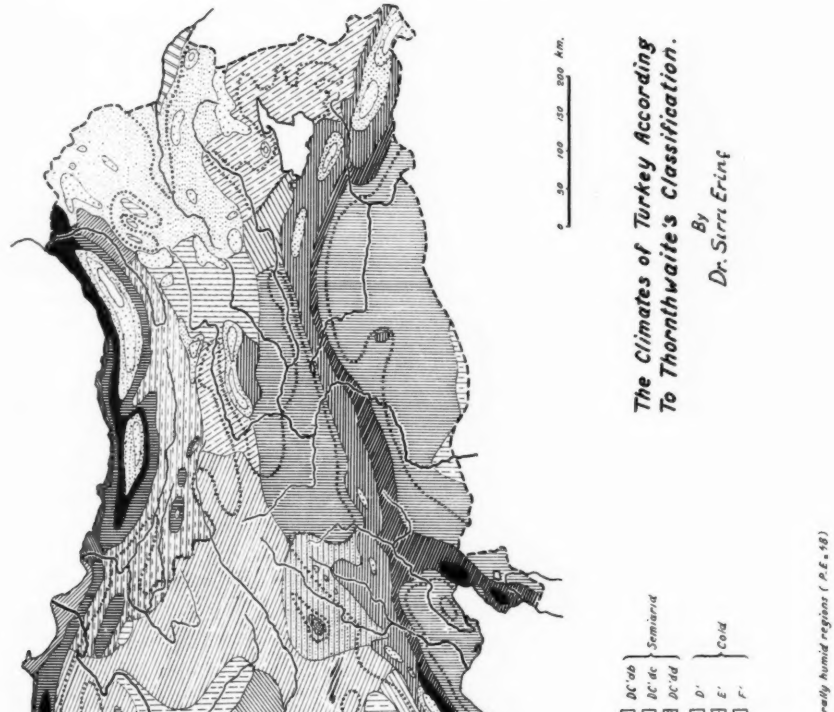
The Climates of Turkey According To Thornthwaite's Classification.
By Dr. Sırrı Erinç
0 50 100 150 200 km.
Key to Shading
AB'r-b AB'sb Superhumid mesothermal
AC'r AC's Superhumid microthermal
BB'ra BB'rb BB'sb Humid mesothermal
BC'r BC's Humid microthermal
CB'rb CB'sb CB'dc Subhumid mesothermal
CC'sb CC'db CC'rc CC'sc CC'dc CC'rd Subhumid microthermal
DC'db DC'dc DC'dd Semiarid
D' E' F' Cold
Limit between generally arid and generally humid regions (P.E.=48)

FIG. 2.

because of that system's widespread use. It is, at present, indispensable for the comparison of Turkey's climates with those of the other regions to which the original system has been applied.

PART I

THE CLIMATES OF TURKEY ACCORDING TO THORNTHWAITE'S ORIGINAL CLASSIFICATION

The climatic map (Fig. 2) reveals that various climatic types are present, apparently because of the country's transitional situation between the areas of temperate and subtropical climates and of its irregular relief. Three classes of cold climate together with superhumid, humid, subhumid, and semiarid climates are found. Taking into account minor sub-divisions, a total of twenty four types may be distinguished. But the areas of various types are not equal. The greater part of Turkey has climates which are sub-types of the subhumid group (C).

The types in Thrace are few in number. This peninsula may be distinguished as having only subhumid and humid mesothermal types, whereas in Anatolia, i.e., in the Asiatic part of Turkey, great variety may be recognized. The heart of Anatolia has a semiarid and microthermal climate. Surrounding this is a belt of various sub-types of sub-humid climates, widening both to the east and west and extending to the shores of the Aegean Sea and Sea of Marmara on the one hand and to Lake Van on the other. In contrast to this, by far the greater part of the northern and southern coasts of Turkey form a belt of humid and mesothermal climates. Properly superhumid and mesothermal conditions near sea level are found only in the northeastern corner of the Black Sea coast between Rize and the Turco-Russian frontier, where PE indices are over 200. Other superhumid regions in the northern and southeastern parts of the country result from altitude and are therefore mostly microthermal. The main area of cold climates is confined to the northeastern highlands between Erzurum and Kars. Taiga (D′) conditions exist through the greater part of this region. Apart from this compact Taiga area, there are several widely scattered zones of Taiga (D′) and Tundra (E′) conditions on the higher portions of the mountains, especially in the Pontic Mountains, the Taurus, and the East Anatolian ranges. Regions of perpetual frost and snow occur above 3300 meters in the Pontic Mountains; above 3500 meters on the summits of Mount Erciyas (3917 m.), Mount Suphan (4430 m.), Mount Cilo (4170 m.); and above 4400 meters on the summit of Mount Ağri (Ararat, 5165 m.).

In general, outside the regions of cold climates, the temperatures are either mesothermal or microthermal. In spite of the differences in latitude all the coastal regions of the country show mesothermal conditions. But within this major thermal grouping there are discernible differences between various regions. Mediterranean coastal stations have TE indices between 100 and 106; Aegean coasts, between 80 and 94; whereas TE indices along the Sea of Marmara and Black Sea vary between 70 and 80. On the other hand, all of the coastal stations are in the temperature sub-group b, with the single exception of Dörtyol, where summer con-

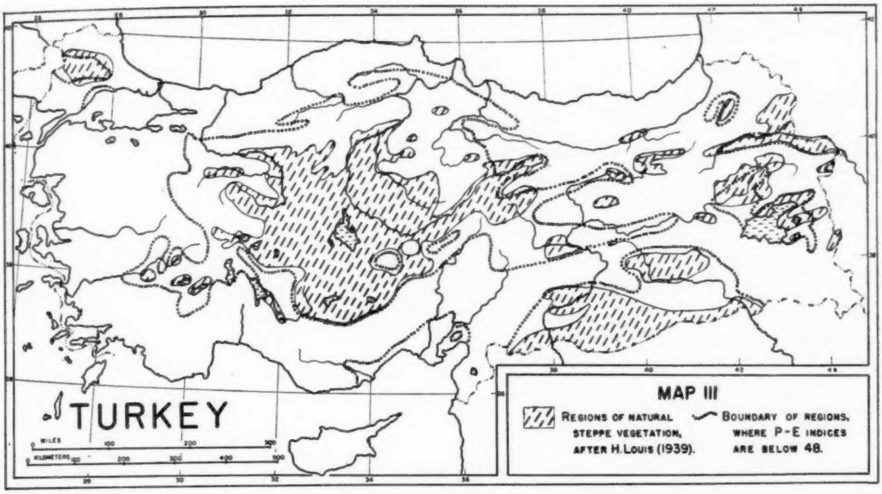

FIG. 3.

centration of the thermal efficiency is 34 per cent, i.e., close to the limit of the subgroup b. In contrast to this all the humid, subhumid, and semiarid areas of the interior are microthermal. Here temperature ranges are larger than elsewhere. Consequently, interior regions have a tendency towards a higher summer concentration of thermal efficiency. This tendency is most apparent in the higher regions of East Anatolia where summer concentration of thermal efficiency is between 52 and 80 per cent.

As regards the seasonal distribution of rainfall effectiveness, there are marked differences between the various regions of Turkey. In the northern part and northeastern highlands rainfall is adequate at all seasons. In contrast to this, by far the greater part of the interior is in group d. In these regions moisture is deficient at all seasons. Further south there is a region where deficient moisture in summer becomes characteristic. This area extends from the western part of the Sea of Marmara to the south and southeast in accord with the prevailing influences of the Mediterranean Sea. Yet there are numerous exceptions to this general pattern. In the northern coastal regions, which fall within group r, the PE indices of the warm season become generally larger eastwards and reach their maximum in the vicinity of Rize. On the other hand, s conditions become more pronounced southwards from the Sea of Marmara to the Mediterranean Sea. In western Anatolia the area within group s is especially large, apparently owing to the parallelism between the directions of the mountain ranges and of the chief rain-bearing winds.

It should be pointed out that the regions where the PE indices are less than

48,[8] which is considered as a divide between generally arid and generally humid climates, include by far the greater part of the interior of the country both in Anatolia and in Thrace. Some large areas of subhumid climate are included in this category. The limits, as shown on Figure 3, correlate rather satisfactorily with the boundaries of the natural steppes.[9] In these regions, crops are subject to the dangers of periodic droughts, and, therefore, irrigation is indispensable to rural life.

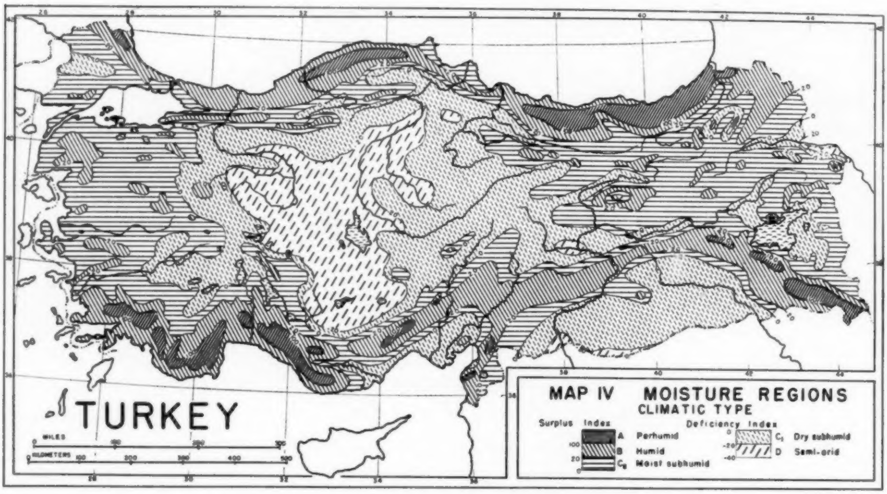

FIG. 4.

PART II

THE CLIMATES OF TURKEY ACCORDING TO THORNTHWAITE'S NEW CLASSIFICATION

Although the new classification is superficially similar to the original system, there are considerable differences, especially insofar as the division of climates according to thermal efficiency is concerned. The new classification gives a clearer idea of water balance and provides the means for determining the water deficiency or water surplus numerically. This is very important for the rational development of irrigation, particularly in subhumid and semiarid regions as in Turkey.

The chief moisture regions in Turkey (Fig. 4) according to the new classification are the same as described above for the old system.[10] The distribution of moisture regions reflects largely the influence of relief. The external slopes of the marginal mountain ranges are humid, whereas the plateaus and basins of the interior

[8] This index is equivalent of the moisture index 0, according to Thornthwaite's new classification.

[9] H. Louis, *Das Natürliche Pflanzenkleid Anatoliens* (Stuttgart, 1939), pp. 24–72.

[10] NOTE BY C. WARREN THORNTHWAITE. See footnote 7.

suffer from moisture deficiency. Perhumid regions near sea level occur only along the northeastern coast of the country where moisture indices are about 200. In this region wheat cultivation is excluded. The chief crop is maize. The other perhumid areas on the Pontic and Taurus mountains are the result of altitude and are confined to the external slopes. The areas of humid climates are more extensive than those of perhumid climates. Two belts of humid climates fringe Central

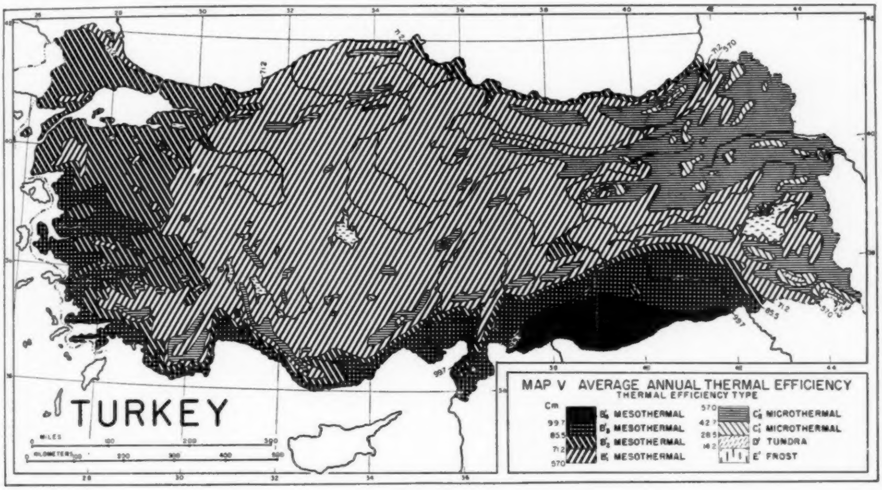

FIG. 5.

Anatolia on the north and south. The northern belt, which occupies the whole Black Sea coast, except for the moist subhumid strip between Samsun and Sinop, corresponds to the chief zone of maize and hazel nut cultivation. The southern humid belt increases in elevation from west to east and moisture indices within it decrease in the same direction in contrast to the northern humid belt.

The greater part of Central Anatolia is encircled by the isarithm of moisture index 0 which separates the dry and moist regions of the country. Interior Thrace, Çukurova (Cilicia), the southeast Anatolian plateaus, and the Araxes Valley are the other important dry regions. More than half of the total area of Turkey is covered by dry climates.

It is noteworthy that these regions are the most important agricultural regions of the country. Central Anatolia, for example, is the greatest grain area of Turkey supplying it with wheat which is the essential food of the Turkish people. More than 60 per cent of the total wheat production of Turkey is concentrated in these dry subhumid and semiarid areas. This means that the center of gravity of Turkey's agricultural economy is here. In these dry regions, especially in their semiarid parts, irrigation is indispensable. Although there are some irrigation

works in these areas, they are insufficient. It must be remembered that the moisture data show only the average situation. In reality, the annual precipitation amount and distribution through the year vary greatly, as is usual in all areas located transitionally between arid and humid climates. Therefore these regions are subject to the terrible consequences of periodic droughts like those in 1804, 1876, and 1928, for example.[11] At such times, drought destroys crops and animals, the helpless peasants leave the land and seek the towns, and the whole economic and social life of Turkey is disrupted.

The distribution of average annual potential evapotranspiration (water need) is shown in Figure 5. The data on which this map is based were determined by calculations made in the manner described by Thornthwaite in his paper of 1948. The average annual water need in Turkey reaches its maximum in the southeast, where it is more than 100 centimeters. Potential evapotranspiration decreases northwards and from the western coast towards the high central and eastern plateau. In west Anatolia it is between 90 and 95 centimeters; in central highlands, less than 70 centimeters; and in northeastern plateaus, from 45 to 55 centimeters.

Characteristic examples of the annual march of water need and rainfall are shown in Figure 6. The march of evapotranspiration follows a uniform pattern in most regions. It is negligible in the winter period, even in most warm parts of Turkey. On the Mediterranean shoreline, e.g., it is less than 2 centimeters a month. The maxima of monthly water needs are reached generally in July. Then, it is more than 20 centimeters in the southeast; about 17 or 18 centimeters in the southern and western coastal regions; about 14 centimeters in central, northwest, and northeast Anatolia, in Thrace, and on the Pontic shoreline. But the march of rainfall is variable from one region to another, as described in Part I of this paper. Consequently balances between water need and water supply differ from one area to another. Water deficiency of various degrees in summer and water surplus in winter characterize all of Turkey, except a small perhumid strip along the northeastern coast. Throughout the greater part of the country water balances are negative from April to November, but a surplus from the winter period stored in the soil prevents the plants from suffering generally until the first half of June. This water storage is vital to agriculture throughout most of Turkey. Without it crops would not be supplied with water necessary for their growth and agriculture would be almost impossible since irrigation works are insufficient. But rainfall and water need are subject to the annual variations, as has been stated. A deficient water storage in winter results in a drought, destructive in proportion as storage is deficient. In contrast, an abundant storage allows the peasant to reap an abundant crop, making it possible for him to resist the consequences of the next drought except where unfavorable periods follow one another in direct sequence.

According to the new classification the potential evapotranspiration is also an index of thermal efficiency. Therefore Figure 5 reflects the distribution of the thermal regions in Turkey. The most important differences between the original

[11] A. Tanoğlu, *Ziraat hayati* (Istanbul, 1942), p. 49.

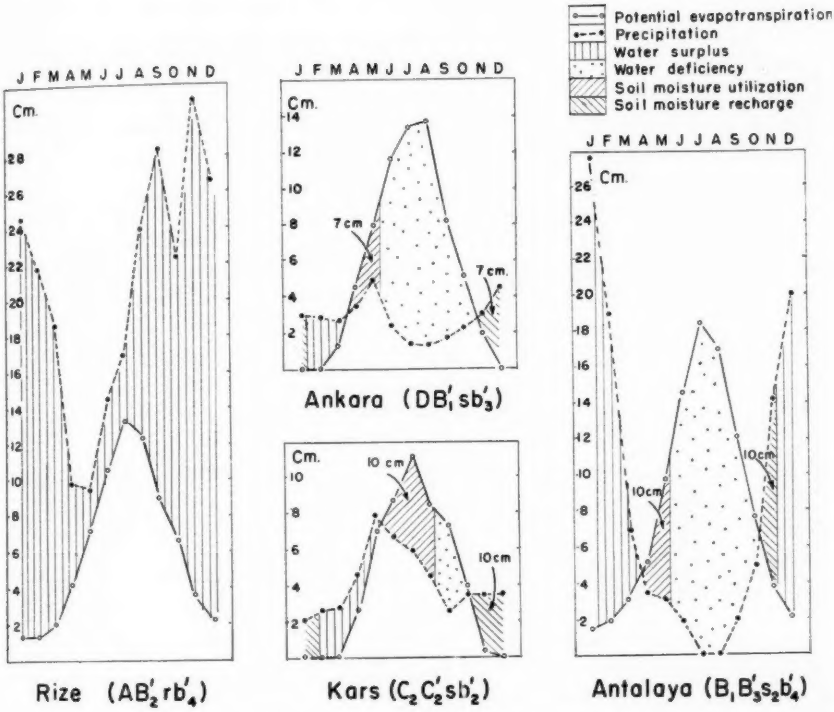

FIG. 6. March of precipitation and potential evapotranspiration in different regions of Turkey.

and new classification are in this aspect. It is because of this that the new climatic limits differ considerably from the old ones.

Mesothermal climates occupy by far the greater part of the country. Southern and western shores are third mesothermal. The greater part of Thrace, northwestern Anatolia, and the northeastern shore are second mesothermal. All of Central Anatolia has a first mesothermal climate. Megathermal conditions do not occur in Turkey. The southeastern region and the vicinity of Dörtyol are fourth mesothermal. The north-eastern highlands are second microthermal. This region was described as the most compact Taiga (D′) area according to the original classification. Regions of first microthermal climates and Tundra are widely scattered and are confined to high mountains. The area of frost climate (E) is very small. This type occurs only on the summits of the most important elevations, for example, on Mount Ağri (5165 m.), Mount Suphan (4430 m.), Mount Cilo (4170 m.), and Mount Kaçkar (3937 m.).

Regarding the summer concentration of thermal efficiency, the greater part of the coastal regions are in subgroup b_4. An exception is the locality Dörtyol which

is in subgroup a. The other parts of Anatolia and Thrace fall either in subgroup b_3 or b_2. It appears that the summer concentration of thermal efficiency according to the original system, as described in Part I of this paper, gives a better idea of the degree of marine or continental influence.

A comparison of Figures 4 and 5 indicates the major climatic types in Turkey according to Thornthwaite's new classification. The necessary data for obtaining the chief groups are given in Appendix II.

In conclusion, it cannot be said that the classification of the climates of Turkey, which this paper has attempted, is complete. Climatic data are still deficient, particularly in the interior, eastern, and higher regions of the country. Moreover, the lengths of the records are not satisfactory. Therefore, many boundaries of the subtypes must be considered as provisional. Nevertheless, this paper presents a survey of the climatic types and suggests regional variety in Turkey.

APPENDIX I.

Climatic Data for Fifty Three Stations In Turkey

Station, height and (duration of record in years)	Class	Figures (Temp. in °C.) (Rainf. in mm.)	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	TE Year	TE Summer concentration (%)
Adana	CB′sb	Temp.	8.7	10.4	12.8	16.9	21.2	25.0	27.6	28.2	25.4	21.2	15.5	10.7	*18.8*	*101.52*	*35.8*
24 m.		Rainf.	82.3	74.7	58.2	41.6	36.6	18.5	6.3	6.7	13.3	51.8	61.7	82.3	*534.0*		
(14)		P–E	7.60	6.30	4.20	2.45	1.80	0.80	0.25	0.28	0.60	2.70	3.05	6.80	*36.83*		
Afyon	CC′db	Temp.	0.3	2.1	5.5	10.7	15.3	19.1	22.4	22.3	17.8	13.3	7.3	3.0	*11.6*	*62.64*	*45.8*
1019 m.		Rainf.	39.0	37.6	39.4	45.3	60.7	36.0	30.8	11.0	15.8	25.6	34.9	42.0	*418.1*		
(14)		P–E	5.90	4.90	4.10	3.55	4.00	1.90	1.45	0.50	0.80	1.65	3.20	5.15	*37.10*		
Akhisar	CB′sb	Temp.	5.6	7.8	9.3	14.6	19.6	24.3	27.1	26.4	22.3	17.6	11.7	7.1	*16.1*	*86.94*	*40.2*
99 m.		Rainf.	96.5	70.1	52.3	53.5	33.4	12.0	3.7	6.9	14.0	39.0	75.3	144.1	*600.8*		
(7)		P–E	10.80	6.60	4.45	3.60	1.75	0.50	0.15	0.30	0.70	2.25	5.90	15.20	*52.20*		
Ankara	CB′db	Temp.	– 0.7	0.7	5.0	11.2	16.2	20.2	23.3	23.6	18.6	13.6	7.4	2.0	*11.8*	*63.72*	*47.3*
891 m.		Rainf.	30.7	29.0	28.0	35.4	50.2	25.8	14.0	13.9	16.7	23.5	31.7	46.8	*345.7*		
(17)		P–E	5.00	4.20	3.02	2.60	3.10	1.25	0.65	0.60	0.90	1.50	2.80	6.20	*31.80*		
Antalya	BB′sb	Temp.	9.9	10.7	12.7	16.1	20.3	24.8	28.1	27.8	24.6	20.2	15.5	11.6	*18.5*	*99.90*	*36.3*
47 m.		Rainf.	279.2	191.6	70.2	34.8	32.6	19.4	1.5	1.7	19.9	50.4	142.7	207.7	*1051.7*		
(14)		P–E	27.50	17.30	5.25	2.05	1.70	0.85	0.06	0.07	0.85	2.70	10.30	18.20	*86.83*		
Balikesir	CB′sb	Temp.	4.4	5.8	6.8	12.7	18.1	21.9	24.5	24.0	19.9	16.1	10.7	5.9	*14.2*	*76.68*	*41.3*
184 m.		Rainf.	105.4	64.9	50.1	59.8	53.6	33.7	12.0	4.9	25.4	52.0	76.0	124.0	*661.8*		
(6)		P–E	12.90	6.80	4.85	4.40	3.12	1.60	0.50	0.20	1.25	3.25	6.30	14.00	*59.17*		
Beyoğlu	CB′rb	Temp.	4.8	5.0	7.5	11.3	16.1	20.6	22.9	22.5	19.6	16.4	11.4	7.4	*13.8*	*74.52*	*39.7*
75 m.		Rainf.	87.0	69.0	62.0	42.0	30.0	34.0	27.0	42.0	52.0	64.0	102.0	122.0	*733.0*		
(47)		P–E	10.20	7.70	5.90	3.15	1.75	1.70	1.24	2.00	2.80	4.05	8.40	12.60	*61.49*		
Beyşehir	CC′sb	Temp.	0.0	1.4	4.5	10.3	15.0	18.9	22.0	22.4	17.2	12.2	6.7	2.3	*11.1*	*59.94*	*47.6*
1128 m.		Rainf.	72.2	58.6	50.4	48.7	24.6	15.3	6.7	5.5	37.2	50.2	47.1	93.2	*509.7*		
(8)		P–E	12.0	8.25	6.10	3.90	1.50	0.80	0.40	0.30	2.20	3.70	4.60	13.00	*56.75*		
Bodrum	BB′sb	Temp.	10.9	11.4	12.4	16.2	20.6	25.1	28.5	27.6	24.3	20.3	16.2	12.7	*18.8*	*101.52*	*35.9*
3 m.		Rainf.	245.9	116.6	71.4	70.8	29.8	8.9	0.2	0.4	3.9	27.5	87.0	208.6	*871.0*		
(6)		P–E	22.60	9.80	5.40	4.50	2.45	0.40	0.01	0.02	0.15	1.35	5.50	17.30	*69.48*		

APPENDIX I (*Continued*)

Station, height and (duration of record in years)	Class	Figures (Temp. in °C.) (Rainf. in mm.)	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	TE Year	TE Summer concentration (%)
Bolu	CC′rb	Temp.	-0.3	1.6	4.5	9.5	13.9	16.9	19.7	19.7	15.8	12.6	6.4	2.4	*10.2*	*55.08*	*46.0*
728 m.		Rainf.	53.6	44.4	39.1	53.5	60.3	52.9	32.1	17.7	29.9	33.7	53.3	52.7	*523.2*		
(14)		P–E	8.60	6.00	4.25	4.45	4.20	3.20	1.65	0.90	1.75	2.30	5.30	6.80	*49.40*		
Burdur	CB′sb	Temp.	1.6	4.1	6.2	11.4	16.6	20.9	24.2	23.8	19.6	15.1	8.6	3.8	*13.0*	*70.20*	*44.1*
1025 m.		Rainf.	73.7	46.0	26.2	41.3	48.9	23.8	4.5	7.6	12.0	30.3	37.6	55.3	*407.2*		
(5)		P–E	10.70	5.20	2.50	3.10	2.95	1.15	0.19	0.30	1.62	1.85	3.25	6.50	*39.31*		
Bursa	CB′rb	Temp.	5.1	5.8	8.2	13.0	17.5	21.5	24.2	23.8	19.9	15.2	10.5	6.5	*14.3*	*77.22*	*40.5*
161 m.		Rainf.	78.4	74.6	54.8	57.6	61.1	28.6	49.6	24.4	42.6	65.6	77.3	86.4	*701.0*		
(14)		P–E	8.80	8.00	5.00	4.15	3.70	1.35	2.30	1.07	2.25	4.40	6.45	9.00	*56.47*		
Çanakkale	CB′sb	Temp.	5.5	6.5	7.9	12.3	17.1	21.7	24.7	24.4	20.5	16.6	11.9	7.9	*14.7*	*79.38*	*39.5*
45 m.		Rainf.	80.2	79.1	62.8	42.4	27.0	25.0	6.3	6.8	28.5	45.6	82.1	111.3	*654.2*		
(12)		P–E	8.80	8.20	5.80	3.05	1.50	1.20	0.25	0.30	1.40	2.75	6.50	11.40	*51.15*		
Çorum	CC′db	Temp.	-1.2	1.2	4.9	10.6	15.4	18.5	21.6	21.5	17.4	12.9	6.9	1.5	*10.8*	*58.32*	*47.5*
803 m.		Rainf.	30.6	23.2	26.6	42.4	55.2	44.8	16.1	16.4	17.1	21.1	32.7	44.3	*370.5*		
(14)		P–E	5.20	3.10	2.75	3.25	3.60	2.50	0.75	0.80	0.90	1.35	3.00	6.00	*33.20*		
Diyarbakir	CB′sb	Temp.	1.3	4.0	8.2	14.0	19.7	25.8	31.0	30.7	24.2	17.4	10.2	4.2	*15.9*	*85.86*	*45.8*
653 m.		Rainf.	65.7	68.4	44.6	58.8	27.0	7.0	1.0	0.2	43.5	31.9	62.4	60.0	*472.5*		
(14)		P–E	9.50	8.10	4.00	4.00	1.40	0.30	0	0	2.0	1.80	5.15	6.90	*43.15*		
Edirne	CB′rb	Temp.	1.7	3.6	7.1	12.6	17.5	21.7	24.7	23.8	19.5	15.0	9.1	3.8	*13.3*	*71.82*	*38.5*
47 m.		Rainf.	46.2	54.1	41.1	47.7	37.9	56.1	36.1	23.3	41.6	55.6	62.5	87.0	*589.2*		
(14)		P–E	6.20	6.40	3.90	3.40	2.20	2.90	1.60	1.00	2.25	3.65	5.50	10.90	*49.90*		
Erzincan	CC′dc	Temp.	-4.2	-1.8	2.9	9.6	15.9	19.5	23.8	24.6	19.7	12.7	6.3	-1.4	*10.7*	*57.78*	*52.8*
1186 m.		Rainf.	26.0	30.9	51.0	67.7	36.8	32.4	17.7	8.0	15.0	31.4	37.2	27.0	*381.1*		
(10)		P–E	4.80	5.50	6.30	5.80	2.25	1.70	0.80	0.40	0.75	2.15	3.70	3.60	*37.75*		
Erzurum	CC′rd	Temp.	-8.7	-6.6	-3.3	5.0	11.0	14.8	19.0	20.0	15.2	8.5	1.9	-4.8	*6.0*	*32.40*	*74.7*
1892 m.		Rainf.	30.1	38.4	42.8	63.8	71.2	52.3	32.0	24.5	25.4	51.3	39.1	29.5	*500.4*		
(14)		P–E	5.50	7.20	7.95	7.00	5.60	3.40	1.70	1.25	1.50	4.50	5.20	5.35	*54.14*		

APPENDIX I (*Continued*)

Station, height and (duration of record in years)	Class	Figures (Temp. in °C.) (Rainf. in mm.)	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	TE Year	TE Summer concentration (%)
Eskişehir	CC′db	Temp.	−0.4	1.4	4.8	10.3	14.9	18.5	21.5	21.1	16.8	12.7	6.7	1.8	*10.9*	*58.86*	*46.6*
790 m.		Rainf.	37.5	29.7	22.3	35.2	49.6	37.2	16.7	5.8	18.3	20.4	37.3	43.0	*307.0*		
(14)		P–E	5.90	4.00	2.25	2.70	3.20	2.00	0.80	0.28	0.95	1.30	3.60	5.75	*32.73*		
Dörtyol	BB′ra	Temp.	10.7	11.8	14.0	17.7	22.0	25.3	27.0	28.1	26.2	22.9	17.7	12.8	*19.7*	*106.38*	*34.0*
70 m.		Rainf.	120.1	123.9	120.2	110.8	68.4	54.2	32.4	60.6	81.4	96.6	85.8	127.4	*1081.8*		
(14)		P–E	10.50	10.30	9.00	7.10	3.55	2.45	1.34	2.57	3.80	5.50	5.30	10.10	*75.51*		
Florya	CB′rb	Temp.	4.6	5.8	6.6	11.0	15.8	20.1	23.3	23.3	19.4	15.9	13.0	7.2	*13.7*	*73.98*	*40.5*
34 m.		Rainf.	57.5	56.8	38.6	47.7	32.8	32.6	19.2	24.9	67.6	83.2	77.3	109.7	*647.9*		
(7)		P–E	6.40	5.90	3.70	3.70	1.95	1.65	0.90	1.10	3.85	5.50	5.70	11.50	*51.76*		
Giresun	BB′rb	Temp.	6.7	6.6	7.5	10.9	15.6	20.0	22.8	23.4	20.0	17.3	12.9	8.7	*14.5*	*78.30*	*38.0*
21 m.		Rainf.	131.6	112.9	108.6	81.8	51.0	76.0	96.8	146.8	147.7	123.7	183.1	135.4	*1402.6*		
(9)		P–E	14.20	12.25	11.10	6.85	3.25	4.30	5.10	8.00	9.00	8.15	14.95	13.10	*110.25*		
Göztepe	CB′rb	Temp.	5.3	5.3	7.2	11.7	16.3	20.5	23.2	23.3	19.6	16.3	11.6	7.5	*13.9*	*75.06*	*40.1*
40 m.		Rainf.	62.8	73.7	44.7	35.7	33.1	26.5	28.8	22.8	47.3	72.9	75.5	89.0	*612.8*		
(14)		P–E	6.80	8.10	4.20	2.60	1.95	1.30	1.30	1.00	2.60	4.70	6.00	8.80	*49.45*		
İzmir	CB′sb	Temp.	8.3	8.9	11.2	15.2	19.9	24.6	27.7	27.1	22.8	18.7	14.0	9.9	*17.4*	*93.96*	*35.7*
3 m.		Rainf.	115.1	96.4	63.5	47.1	33.1	8.9	4.4	1.3	20.4	62.2	75.1	112.4	*639.9*		
(14)		P–E	11.40	8.95	5.00	3.00	1.75	0.45	0.18	0.05	0.95	3.55	5.20	10.10	*50.58*		
İslahiye	BB′sb	Temp.	4.2	7.0	9.7	15.6	20.6	25.0	27.7	27.6	24.5	19.2	12.9	7.5	*16.7*	*90.18*	*40.0*
514 m.		Rainf.	240.9	114.6	93.7	44.6	24.8	7.9	1.4	10.2	8.0	73.0	143.5	140.3	*902.9*		
(6)		P–E	32.43	12.10	8.55	2.80	1.10	0.35	0.05	0.45	0.35	4.20	11.50	14.60	*88.48*		
İsparta	CB′sb	Temp.	1.6	2.8	5.9	10.7	15.4	19.7	23.3	23.2	18.7	13.7	8.0	3.5	*12.2*	*65.88*	*45.2*
1050 m.		Rainf.	78.2	80.7	52.9	56.7	50.0	35.9	10.8	15.3	18.0	41.2	52.0	80.7	*572.4*		
(14)		P–E	11.40	10.80	5.45	4.60	3.20	1.90	0.52	0.70	0.93	2.75	4.75	10.20	*57.20*		
Kars	D′	Temp.	−11.9	−8.3	−4.4	4.6	10.7	13.7	17.4	18.1	13.7	7.7	1.1	−7.1	*4.6*	*24.84*	*89.1*
1750 m.		Rainf.	23.3	25.8	28.8	46.3	78.3	66.1	61.2	46.6	27.2	35.0	35.6	25.9	*500.0*		
(14)		P–E	4.25	4.70	5.20	5.05	6.40	4.65	3.70	2.65	1.75	3.10	5.00	4.70	*51.15*		

APPENDIX I (*Continued*)

Station, height and (duration of record in years)	Class	Figures (Temp. in °C.) (Rainf. in mm.)	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	TE Year	TE Summer concentration (%)
Kastamonu 800 m. (14)	CC′db	Temp.	-1.9	0.7	4.4	9.6	15.2	17.6	20.8	20.2	16.0	11.7	5.3	0.5	*10.0*	*54.0*	*48.8*
		Rainf.	24.2	25.4	29.2	47.6	86.1	63.5	34.5	39.1	27.4	29.5	33.4	31.7	*365.6*		
		P–E	4.30	3.60	3.20	4.00	6.15	3.80	1.70	2.00	1.60	2.10	3.40	4.60	*40.45*		
Kayseri 1055 m. (11)	CB′dc	Temp.	-2.7	0.3	4.7	10.9	16.0	19.8	23.2	22.9	18.1	12.8	6.5	1.3	*12.1*	*65.34*	*58.8*
		Rainf.	42.7	34.6	37.6	55.4	48.2	25.0	8.6	15.9	13.9	25.1	36.1	36.0	*379.1*		
		P–E	7.95	5.10	4.00	4.35	3.00	1.25	0.40	0.73	0.70	1.70	3.50	5.00	*37.68*		
Kirşehir 970 m. (14)	CC′sb	Temp.	-0.3	1.5	5.1	10.8	15.7	19.4	23.3	23.1	18.1	13.0	6.7	1.9	*11.5*	*62.10*	*47.6*
		Rainf.	43.6	34.7	32.0	36.5	41.7	28.7	5.7	6.0	11.7	22.9	34.6	55.3	*327.6*		
		P–E	7.00	4.70	3.30	2.80	2.60	1.50	0.25	0.28	0.60	1.45	3.25	7.40	*35.13*		
Kocaeli (-izmit) 77 m. (11)	CB′rb	Temp.	5.5	5.4	7.5	12.2	17.2	20.8	23.2	22.9	20.4	16.6	11.7	7.4	*14.2*	*76.68*	*39.0*
		Rainf.	81.9	73.8	55.9	49.5	56.4	57.1	67.4	43.4	79.8	71.3	73.8	103.5	*813.8*		
		P–E	9.00	8.05	5.20	3.65	3.40	3.05	3.40	2.05	4.45	4.50	5.80	10.50	*63.05*		
Konya 1024 m. (14)	DC′db	Temp.	-0.5	1.9	5.5	11.2	16.0	16.3	23.4	23.3	18.4	13.2	6.8	1.6	*11.4*	*61.56*	*46.7*
		Rainf.	36.0	28.6	26.8	29.3	39.9	25.3	6.4	4.4	12.6	28.0	30.2	36.0	*303.5*		
		P–E	5.80	3.70	2.70	2.10	2.35	1.40	0.30	0.20	0.65	1.80	2.80	4.80	*28.60*		
Kütahya 970 m. (14)	CC′sb	Temp.	0.1	1.6	4.9	9.9	14.3	17.9	20.6	19.0	16.0	12.6	7.0	2.2	*10.5*	*56.70*	*45.6*
		Rainf.	68.2	55.6	39.9	43.0	56.4	39.0	21.4	16.5	20.8	34.1	49.5	69.8	*514.2*		
		P–E	11.00	7.60	4.30	3.45	3.80	2.20	1.10	0.85	1.20	2.35	4.75	9.50	*52.10*		
Lüleburgaz 70 m. (7)	CB′rb	Temp.	2.5	3.3	6.0	11.5	16.6	20.7	23.8	23.5	18.9	14.6	9.3	4.7	*12.9*	*69.66*	*43.9*
		Rainf.	57.5	54.0	37.1	45.9	69.9	38.6	17.3	10.2	27.9	53.8	80.5	69.5	*562.2*		
		P–E	7.40	6.50	3.70	3.40	4.40	1.95	0.80	0.45	1.35	3.50	7.10	8.00	*48.55*		
Malatya 977 m. (14)	CB′sb	Temp.	-1.7	0.5	6.3	12.6	18.1	22.5	26.3	26.7	21.8	15.5	7.9	1.1	*13.1*	*70.74*	*48.0*
		Rainf.	39.1	49.6	40.5	51.0	27.9	13.1	2.6	3.0	8.3	34.2	44.2	36.9	*350.4*		
		P–E	7.00	5.80	3.65	3.65	1.50	0.60	0.10	0.11	0.40	2.05	4.00	5.10	*34.31*		
Manisa 61 m. (14)	CB′sb	Temp.	6.5	7.5	10.4	15.0	19.7	24.5	27.6	27.0	22.7	18.1	12.1	7.6	*16.6*	*89.64*	*39.7*
		Rainf.	96.3	98.7	63.9	64.0	40.9	13.1	9.8	3.1	27.2	61.6	68.5	114.1	*661.2*		
		P–E	10.20	9.90	5.20	4.25	2.20	0.60	0.30	0.11	1.12	3.60	5.20	11.60	*53.28*		

APPENDIX I (*Continued*)

Station, height and (duration of record in years)	Class	Figures (Temp. in °C.) (Rainf. in mm.)	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	TE Year	TE Summer concentration (%)
Merzifon	DC′dc	Temp.	0.4	2.4	4.9	11.0	15.4	18.8	20.8	20.9	17.9	14.4	7.2	1.6	*11.3*	*61.02*	*51.9*
730 m.		Rainf.	30.4	25.4	25.7	50.2	60.9	55.0	12.4	12.8	14.8	22.1	30.6	31.3	*371.6*		
(7)		P–E	4.40	3.10	2.60	4.00	4.00	3.10	0.65	0.65	0.80	1.30	2.80	4.10	*31.50*		
Muğla	AB′sb	Temp.	5.2	6.5	8.4	12.6	17.4	22.6	26.1	25.4	21.4	16.5	10.8	6.9	*15.0*	*81.0*	*44.5*
648 m.		Rainf.	302.9	218.4	131.1	97.5	37.6	14.7	9.0	14.6	15.7	96.9	157.3	397.8	*1443.5*		
(9)		P–E	39.26	25.20	12.90	7.50	2.15	0.70	0.40	0.65	0.72	6.40	4.00	40.00	*149.88*		
Nazilli	CB′sb	Temp.	7.3	9.1	11.3	15.7	20.4	25.4	28.4	27.5	23.2	18.3	11.2	8.6	*17.2*	*92.88*	*48.0*
90 m.		Rainf.	109.8	93.7	63.8	46.7	35.5	12.1	2.1	6.9	11.1	66.0	76.8	143.4	*687.6*		
(9)		P–E	11.40	8.50	5.00	2.90	1.80	0.50	0.05	0.30	0.50	3.90	6.20	14.00	*55.05*		
Niğde	CC′db	Temp.	−0.8	1.4	4.5	11.0	15.9	19.7	23.0	23.1	18.3	13.3	6.3	1.6	*11.4*	*61.56*	*47.0*
1239 m.		Rainf.	52.8	38.9	33.3	38.9	47.2	28.1	5.4	17.2	18.7	35.7	42.0	41.8	*400.0*		
(9)		P–E	8.90	5.30	3.50	3.00	2.90	1.40	0.25	0.80	0.97	2.40	4.10	5.70	*40.22*		
Rize	AB′rb	Temp.	7.0	6.9	8.0	11.4	15.8	19.5	22.2	22.6	19.8	17.2	12.9	9.2	*14.7*	*78.38*	*36.9*
65 m.		Rainf.	246.7	218.6	186.7	98.5	95.3	146.4	169.4	241.7	284.5	224.8	313.2	267.3	*2493.1*		
(14)		P–E	28.00	24.50	19.30	8.05	6.40	9.05	9.80	14.20	18.60	15.75	26.90	27.10	*207.65*		
Samsun	CB′rb	Temp.	6.6	6.7	7.7	11.1	15.5	19.8	23.3	23.5	20.1	17.1	12.7	8.9	*14.4*	*77.76*	*38.4*
23 m.		Rainf.	66.9	60.1	65.1	54.9	40.1	40.4	53.7	30.9	52.7	56.3	86.8	83.7	*691.8*		
(14)		P–E	6.80	6.00	6.10	4.25	2.50	2.10	2.60	1.38	2.80	3.40	6.60	7.50	*52.03*		
Sinop	CB′rb	Temp.	6.6	6.3	6.1	9.7	14.3	19.3	22.9	23.3	19.7	16.9	12.5	8.7	*13.9*	*75.06*	*39.2*
25 m.		Rainf.	67.3	47.9	39.7	43.9	34.6	23.0	34.9	31.5	86.0	65.9	96.8	97.3	*668.8*		
(6)		P–E	6.80	4.80	3.95	3.60	2.20	1.18	1.60	1.40	5.00	4.10	7.50	9.10	*51.23*		
Sivas	CC′rc	Temp.	−4.9	−2.6	1.6	8.2	13.2	16.2	19.2	19.9	15.9	11.1	4.7	−0.9	*8.4*	*45.36*	*54.7*
1285 m.		Rainf.	41.7	37.7	42.3	60.0	59.3	30.8	7.2	5.2	23.0	35.8	44.8	45.0	*432.8*		
(14)		P–E	7.80	7.05	5.80	5.50	4.20	1.80	0.35	0.25	1.30	2.70	4.90	7.50	*49.15*		
Trabzon	BB′rb	Temp.	7.0	6.7	7.5	11.2	15.6	19.7	22.6	23.2	20.0	17.3	12.9	8.8	*14.4*	*77.76*	*37.9*
108 m.		Rainf.	84.5	74.0	68.4	64.4	47.8	51.1	50.3	51.3	76.4	102.6	121.7	87.2	*879.7*		
(11)		P–E	8.55	7.45	6.60	5.10	3.00	2.80	2.45	2.45	4.30	6.60	9.60	8.00	*66.90*		

APPENDIX I (*Continued*)

Station, height and (duration of record in years)	Class	Figures (Temp. in °C.) (Rainf. in mm.)	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	TE Year	TE Summer concentration (%)
Ulukişla	CC′sc	Temp.	-1.7	-0.4	1.6	9.1	14.5	18.4	21.4	21.2	15.9	10.1	5.6	0.3	*9.7*	*52.38*	*56.2*
1430 m.		Rainf.	61.9	50.5	41.8	50.8	36.5	28.8	5.6	18.8	12.7	25.5	43.3	38.9	*415.1*		
(6)		P–E	12.00	8.00	5.60	4.30	2.35	1.50	0.25	0.90	0.70	1.90	4.50	5.80	*47.80*		
Urfa	CB′sb	Temp.	4.5	7.1	10.0	15.6	20.4	27.9	32.0	31.4	28.5	20.3	13.0	7.2	*18.2*	*98.28*	*41.8*
515 m.		Rainf.	108.8	70.8	53.0	43.4	6.1	1.1	1.0	0.1	1.5	18.0	51.8	72.6	*428.2*		
(9)		P–E	13.20	7.00	4.30	2.70	0.30	0.04	0.01	0	0.06	0.90	3.65	7.10	*38.45*		
Uşak	CB′sb	Temp.	1.6	2.5	5.2	10.5	15.6	20.1	23.6	23.5	18.3	11.7	7.6	3.4	*12.0*	*64.8*	*46.6*
913 m.		Rainf.	82.7	54.7	54.6	39.4	59.0	20.5	15.4	13.5	20.0	39.8	56.8	86.7	*543.1*		
(12)		P–E	12.20	7.00	5.85	3.05	3.80	1.00	0.72	0.60	1.05	2.45	5.30	11.20	*54.72*		
Üsküdar	CB′rb	Temp.	4.4	4.5	7.2	10.8	15.6	20.0	22.9	22.9	19.4	15.6	10.8	7.0	*13.4*	*72.36*	*40.9*
18 m.		Rainf.	82.0	63.0	81.0	37.0	35.0	43.0	30.0	44.0	59.0	68.0	93.0	101.0	*736.0*		
(22)		P–E	9.80	7.15	8.00	2.60	2.10	2.30	1.37	2.05	3.30	4.45	7.80	10.50	*61.42*		
Van	CC′dc	Temp.	-3.5	-1.9	0.9	7.4	13.8	18.2	22.6	22.8	18.0	11.9	5.7	0.0	*9.7*	*52.38*	*58.4*
1804 m.		Rainf.	47.1	28.2	59.9	61.7	39.9	15.7	7.1	2.9	9.1	39.9	57.1	32.5	*401.1*		
(7)		P–E	7.90	5.00	8.90	5.90	2.70	0.80	0.34	0.12	0.48	2.90	6.00	5.00	*40.14*		
Vaniköy	CB′rb	Temp.	5.5	4.7	7.7	11.3	15.3	20.1	22.4	22.4	19.5	15.5	12.2	7.6	*13.8*	*74.52*	*39.1*
115 m.		Rainf.	82.2	57.2	43.2	63.5	40.0	38.5	31.8	42.6	46.1	73.8	96.2	108.1	*696.2*		
(19)		P–E	9.00	6.40	3.95	5.00	2.50	2.00	1.45	2.04	2.50	4.90	7.60	11.00	*58.34*		
Yalova	CB′rb	Temp.	6.1	6.3	7.8	11.7	16.6	20.4	22.9	22.9	19.5	16.8	12.0	7.5	*14.2*	*76.68*	*38.8*
2 m.		Rainf.	90.9	71.9	51.4	49.4	45.7	43.4	36.0	34.8	51.7	70.6	91.7	111.3	*749.8*		
(8)		P–E	9.80	7.90	4.80	3.70	2.75	2.30	1.70	1.67	2.81	4.40	7.30	11.40	*60.03*		
Zonguldak	BB′rb	Temp.	5.4	5.9	6.0	10.3	15.2	19.1	21.5	20.9	17.5	15.3	10.6	7.3	*12.9*	*69.66*	*39.7*
42 m.		Rainf.	141.3	71.2	83.9	97.3	55.5	36.2	42.9	98.1	102.2	127.5	163.8	174.5	*1194.4*		
(5)		P–E	16.50	7.50	9.00	8.40	3.60	1.90	2.10	5.50	6.50	9.10	14.70	18.70	*103.5*		

APPENDIX II.

Necessary Data for Obtaining the Chief Climatic Types According to Thornthwaite's New (1948) Classification

Station and latitude	Potential evapotranspiration														Moisture index	Chief climatic type
	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	Summer concentration (%)		
Adana 37° N	1.2	1.7	3.2	5.8	10.4	14.7	17.5	16.5	12.8	8.4	3.8	1.8	97.8	49.7	−14.0	$C_1B'_3$
Afyon 38° 50′ N	0	0.2	1.7	4.7	8.1	11.2	13.9	12.9	8.5	5.2	2.1	0.5	69.0	55.0	−13.5	$C_1B'_1$
Akhisar 38° 55′ N	0.7	1.3	2.2	5.1	10.1	14.6	16.8	16.2	10.2	6.2	2.6	1.0	87.0	54.7	5.2	$C_2B'_3$
Ankara 40° N	0	0	1.4	4.6	8.1	11.7	13.4	13.9	8.3	5.2	2.0	0	68.6	56.8	−20.2	DB'_1
Antalya 36° 52′ N	1.6	2.0	3.2	5.2	9.7	14.7	18.5	17.0	12.1	7.7	3.8	2.1	97.6	50.2	48.5	$B_1B'_3$
Balikesir 39° 40′ N	0.6	1.0	1.7	4.8	9.1	13.1	15.2	13.5	9.1	5.8	2.8	1.1	77.8	53.5	13.8	$C_2B'_2$
Beyşehir 37° 40′ N	0	0	1.5	4.7	7.9	12.0	13.7	13.1	8.2	4.9	2.0	0.5	68.5	56.6	10.8	$C_2B'_1$
Bodrum 37° N	1.9	2.0	2.8	5.1	9.8	14.7	18.8	16.8	11.6	7.7	4.0	2.4	97.6	51.5	26.7	$B_1B'_3$
Bolu 40° 45′ N	0	0.2	1.7	4.5	7.8	9.9	12.0	11.3	7.4	5.5	2.1	0.6	63.0	52.6	1.7	$C_2B'_1$
Burdur 37° 43′ N	0	0.8	1.7	4.6	8.6	12.0	14.7	13.3	9.1	5.7	2.2	0.7	73.4	54.4	−10.8	$C_1B'_2$
Bursa 40° 10′ N	0.9	1.1	2.3	5.0	8.7	12.5	14.7	13.3	9.1	5.2	2.8	1.3	76.9	52.6	10.5	$C_2B'_2$
Çanakkale 40° 08′ N	0.9	1.2	2.1	4.7	8.6	13.0	15.2	14.0	9.5	6.4	3.3	1.7	80.6	52.2	3.8	$C_2B'_2$
Çorum 40° 33′ N	0	0	1.5	4.6	8.2	10.7	13.5	12.6	8.2	5.1	1.9	0	66.3	55.5	−18.5	$C_1B'_1$
Diyarbakir 37° 54′ N	0	0.4	1.6	4.7	10.0	16.1	20.8	19.5	11.7	6.1	2.1	0.5	93.5	60.3	−6.1	$C_1B'_3$

APPENDIX II (*Continued*)

Station and latitude	Potential evapotranspiration														Moisture index	Chief climatic type
	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	Summer concen- tration (%)		
Dörtyol 36° 50′ N	1.6	1.9	3.4	6.0	11.4	15.1	16.3	17.3	13.9	9.9	3.5	2.2	102.5	47.5	34.3	$B_1B'_4$
Beyoğlu 41° N	0.9	1.0	2.1	4.3	8.0	11.6	13.8	12.8	9.1	6.6	3.2	1.6	75.0	50.9	16.7	$C_2B'_2$
Edirne 41° 40′ N	0	0.5	2.0	5.1	9.0	13.2	14.7	13.6	8.9	5.5	2.2	0.6	75.3	55.1	2.3	$C_2B'_2$
Erzincan 39° 44′ N	0	0	0.7	3.8	8.6	11.2	14.2	14.5	9.5	4.9	1.7	0	69.1	57.7	– 12.8	$C_1B'_1$
Erzurum 39° 55′ N	0	0	0	2.6	6.8	9.1	12.0	12.0	7.8	4.0	0.7	0	55.0	60.1	7.6	$C_2C'_2$
Eskişehir 39° 46′ N	0	0.1	1.6	4.6	7.9	10.6	13.3	12.0	7.8	5.1	2.0	0.4	65.4	54.8	– 19.1	$C_1B'_1$
Florya 41° N	0.8	1.1	1.8	4.2	7.5	11.3	14.2	13.3	8.8	5.9	3.9	1.6	74.4	52.1	4.6	$C_2B'_2$
Giresun 40° 55′ N	1.3	1.3	2.0	3.8	7.5	11.1	13.9	13.4	9.2	6.7	3.6	2.0	75.8	50.6	77.7	$B_3B'_2$
Göztepe 41° N	0.5	0.5	1.9	4.5	7.1	11.7	14.2	13.4	8.9	6.2	3.2	1.6	73.7	53.3	1.7	$C_2B'_2$
İzmir 38° 24′ N	1.5	1.6	3.0	5.5	10.2	14.2	18.0	15.2	10.9	7.1	3.6	1.9	92.7	51.1	3.1	$C_2B'_3$
İslahiye 37° 03′ N	0.2	0.5	2.2	5.6	9.3	14.7	18.1	16.8	11.8	6.4	3.0	0.7	89.3	55.5	55.3	$B_2B'_3$
İsparta 37° 46′ N	0	0.4	1.7	4.4	7.7	11.6	14.2	13.2	8.6	5.1	2.1	0.6	69.6	56.0	11.5	$C_2B'_1$
Kars 40° 36′ N	0	0	0	2.7	7.0	8.8	11.1	8.3	7.3	3.9	0.4	0	49.5	56.9	3.8	$C_2C'_2$
Kastamonu 41° 22′ N	0	0	1.6	4.5	8.5	10.0	12.8	11.5	7.6	4.9	1.6	0	63.0	54.4	– 9.5	$C_1B'_1$
Kayseri 38° 43′ N	0	0	1.4	4.6	8.6	11.2	14.4	13.4	8.4	4.8	1.8	0	68.6	56.8	– 13.0	$C_1B'_1$

APPENDIX II (*Continued*)

Station and latitude	Potential evapotranspiration														Moisture index	Chief climatic type
	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	Summer concen-tration (%)		
Kirşehir 39° 08′ N	0	0	1.5	4.6	8.3	11.6	14.4	13.2	8.4	5.0	1.8	0.4	69.2	55.2	− 16.1	$C_1B'_1$
Kocaeli 40° 46′ N	1.4	1.3	2.0	4.6	8.6	11.7	14.0	12.9	9.3	6.2	3.1	1.5	76.6	50.3	18.7	$C_2B'_2$
Konya 37° 50′ N	0	0.2	1.9	4.9	8.6	11.7	14.3	13.3	8.7	5.2	2.0	0	70.8	55.5	− 24.2	DB'_1
Kütahya 39° 24′ N	0	0.1	1.7	4.6	7.9	10.2	12.9	10.8	7.6	5.3	2.3	0.5	63.9	53.0	5.1	$C_2B'_1$
Lüleburgaz 41° 24′ N	0.3	0.5	1.7	4.6	8.7	12.3	14.7	13.6	8.7	5.5	2.6	0.9	74.1	54.7	0.6	$C_2B'_2$
Malatya 38° 20′ N	0	0	1.6	4.8	9.2	13.0	16.7	15.0	10.5	5.5	1.7	0	78.0	57.3	− 17.1	$C_1B'_2$
Manisa 38° 37′ N	0.9	1.1	2.6	5.2	9.8	14.2	18.0	15.2	10.9	6.4	2.8	1.2	88.3	57.0	6.5	$C_2B'_3$
Merzifon 40° 53′ N	0	0.4	1.6	4.9	8.5	10.8	12.8	12.1	8.7	5.9	2.1	0	67.8	52.6	− 20.6	DB'_1
Muğla 37° 12′ N	0.8	1.1	2.2	4.6	8.2	12.9	16.2	14.5	9.9	6.0	2.8	1.3	80.5	54.1	123.1	AB'_2s_2
Nazilli 37° 55′ N	1.1	1.5	2.8	5.5	10.4	15.3	18.8	16.7	11.2	6.5	2.3	1.4	93.5	52.1	8.7	$C_2B'_3$
Niğde 37° 58′ N	0	0	1.3	4.7	8.4	11.2	14.1	13.2	8.5	5.1	1.7	0	68.2	56.4	− 9.7	$C_1B'_1$
Rize 41° 02′ N	1.4	1.4	2.2	4.3	7.6	10.6	13.3	12.4	9.0	6.7	3.6	2.2	74.7	48.5	199.5	AB'_2r
Samsun 41° 18′ N	1.4	1.4	2.1	4.1	7.2	10.6	14.0	12.3	9.1	6.5	3.6	2.0	74.3	49.6	5.0	$C_2B'_2$
Sinop 42° 02′ N	1.4	1.4	1.6	3.5	6.9	10.7	14.3	13.5	9.1	6.6	3.7	2.1	74.8	51.4	4.0	$C_2B'_2$
Sivas 39° 45′ N	0	0	0.5	3.9	7.6	9.6	11.9	11.6	7.8	4.8	1.6	0	59.3	55.8	1.3	$C_2B'_1$

APPENDIX II (*Continued*)

Station and latitude	Potential evapotranspiration														Moisture index	Chief climatic type
	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year	Summer concentration (%)		
Trabzon 41° N	1.4	1.4	2.0	4.1	7.5	10.9	13.7	13.3	9.3	6.9	3.6	2.0	76.1	49.8	23.6	$B_1B'_2$
Ulukişla 37° 32′ N	0	0	0.4	3.2	7.9	10.7	13.1	12.1	7.5	4.2	1.8	0	60.9	58.9	−0.2	$C_1B'_1$
Urfa 37° 08′ N	0	0.7	1.8	4.7	9.6	18.0	21.6	19.8	15.5	7.5	2.5	0.7	102.4	58.0	−12.0	$C_1B'_4$
Uşak 38° 40′ N	0.1	0.4	1.6	4.3	7.9	11.4	14.3	13.3	8.5	4.3	2.1	0.7	68.9	56.6	8.3	$C_2B'_1$
Van 38° 28′ N	0	0	0	3.1	70.3	10.5	14.1	13.3	8.6	4.8	1.7	0	63.4	59.7	−9.8	$C_1B'_1$
Vaniköy 41° 05′ N	1.4	0.9	2.2	4.5	7.5	11.4	13.9	13.0	9.0	5.9	3.6	1.7	75.0	51.0	12.8	$C_2B'_2$
Üsküdar 41° N	0.9	1.0	2.1	4.3	8.0	11.3	14.0	13.2	9.0	6.1	3.2	1.6	74.7	51.5	16.7	$C_2B'_2$
Yalova 40° 39′ N	1.2	1.2	2.2	4.4	8.1	11.6	13.9	13.0	8.8	6.5	3.4	1.6	75.9	50.7	15.0	$C_2B'_2$
Zonguldak 41° 27′ N	1.3	1.4	1.8	4.1	7.6	10.8	13.3	11.7	7.8	5.9	3.1	1.8	70.6	50.7	69.3	$B_3B'_1$

COMMUNICATION

March 9, 1949

To the Editor of the *Annals of the Association of American Geographers:*

In my Presidential Address before the AAG in 1946 (*Annals,* Vol. XXXVII, 1–12) I distinguished between the study of geographical knowledge, to which I applied the term *geosophy,* and the geography of knowledge, for which I suggested (none too seriously) the term *sophogeography,* innocently believing that I had invented both terms. Professor L. E. Klimm, however, has kindly called to my attention the following quotation in Charles Redway Dryer's Presidential Address in 1919 (*Annals,* Vol. X, 1920, p. 13) from a paper by Henry Wilson, President of the Arts and Crafts Society in Great Britain, entitled "The Geography of Culture and the Culture of Geography" (*Geographical Teacher,* Vol. IX, 1918, p. 196):

"There is a geography of thought, a geography of spirit, geography of psychology, of racial influence, a superphysical geography—in fine a geosophy. We want maps of mind, showing the thought and culture currents, idea drifts, spiritual isobars, contours of artistic altitudes."

This is an excellent definition of *Sophogeography!*

John K. Wright

ABSTRACTS OF PAPERS PRESENTED AT THE 1948 ANNUAL MEETINGS IN MADISON, WISCONSIN

DECEMBER 27, 28, 29, 30, 1948

CENSUS BUREAU PAPERS

C. E. BATSCHELET—*Geographical Work in The Bureau of The Census.*

A survey of the geographic work in the Bureau of the Census since its organization as a permanent office in 1902 shows a marked improvement in the techniques employed and an extensive use of detailed maps and aerial photographs.

In preparing for a census a tremendous amount of geographic work is involved. Suitable maps must be secured or compiled, the boundaries of the areas for which Census statistics are published must be clearly defined and mapped, and the entire United States must be subdivided into districts suitable for the field canvass, taking into account the population density, shifts in population since the last Census, transportation facilities, and other factors. Each enumerator is furnished with a map and description of the territory he is to canvass. In the rural areas, the enumerators must identify on their maps each dwelling visited.

For the Census of 1950 boundaries are being defined and mapped for the larger unincorporated communities and for the densely populated areas contiguous to the cities having 50,000 or more inhabitants. It is expected that a more realistic definition of the urban and rural population will result.

It is planned to include a Statistical Atlas in the 1950 Census publications. The Statistical Atlas was first published in 1870 and has been issued for each Census since that time.

A technique known as area sampling is in use in the bureau of the Census. Sampling produces quick and inexpensive results and is recognized as having a definite place in the collection of statistical data.

The Census of 1950 will cover population and agriculture only, as a recent act of Congress provides for a census of industry an business in 1949 and every five years thereafter.

MARGERY D. HOWARTH AND AUGUST J. NOGARA—*Delimitation of "Urban Areas" for the 1950 Census.*

For the 1950 Census of Population of the United States the Bureau of the Census will present statistical information for a new type of area, called tentatively the "———— urban area" as, for example, the "Detroit Urban Area," covering approximately 145 large urban communities. Delineation of these "urban areas" is part of the larger program of the Bureau to improve its urban-rural classification.

The "urban area" is being delimited for all cities of 50,000 or more inhabitants. It includes, in addition to the corporate area of the central city or cities:

1. Contiguous incorporated places of 2,500 or more inhabitants.

2. Smaller contiguous incorporated places having a nodal concentration of 500 inhabitants.
3. Adjacent unincorporated area having a density of 500 dwelling units (or 2,000 people) per square mile.
4. Outlying incorporated places and unincorporated area having a nodal concentration of 500 inhabitants.
5. Industrial, commercial, recreational, and institutional areas related to the urban population by function.

The criteria used in the delimitation of "urban areas" are based on the following considerations:

1. Comparability.
2. Contiguity.
3. A population density which includes most urban dwellings.
4. Functional integration.
5. Clearly defined boundaries.

Delimitation of "urban areas" is being accomplished by:

1. The establishment of a preliminary line enclosing urban population and land functionally related to this population.
2. A field check on the accuracy of the preliminary line and the establishment of the tentative "urban area."
3. A general review of problems common to many "urban areas" and the establishment of the final limits of each "urban area."

Information to be made available by the Census Bureau for the "urban areas" probably will include detailed maps, and tabulations of population and housing information.

It is intended that "urban area" boundaries be revised for each decennial census.

Geographers are invited to comment on the unresolved problems in the delimitation of "urban areas," and to suggest appropriate designations for this new type of area.

ROBERT C. KLOVE—*Census Geographical Areas.*

To make effective use of the census information for the United States, it is necessary for one to know the types of areas for which the Bureau of the Census has collected and presented data. Census geographical areas fall into three major groups: political areas, special census areas, and census working areas. Statistics are published for units of the first two groups. The third group comprises several types of areas which are used primarily by Census employees to assist them in making the enumerations.

For the Sixteenth Census in 1940 the census working areas consisted of 3 supervisory regions, 104 supervisory areas, 531 supervisory districts, and approximately 148,000 enumeration districts.

Political areas employed in presenting census data are states, counties, minor civil divisions, incorporated places, and city wards.

Special areas defined and delimited by the Bureau of the Census and its advisors may be separated into the following classes:

1. Major United States divisions, composed of whole states.
2. Metropolitan areas, including (a) old areas such as *metropolitan districts* and *industrial areas,* and (b) areas proposed for 1950, the *urban* or *urbanized areas* and the *standard metropolitan areas.*
3. Urban subdivisions, including *census tracts* and *blocks.*
4. Rural subdivisions, called *rural statistical areas,* an experimental area type proposed for one state in 1950.
5. Unincorporated places, first delimited by the Census for 1950, when those with over 500 inhabitants may be reported separately.
6. Type of farming areas, used in a limited way.

The criteria selected for the delimitation of any new area are based on some or all of the following considerations:

1. Use of the Area
2. Size of the Area
3. Contiguity
4. Functional Integration
5. Homogeneity
6. Comparability
7. Acceptable Boundaries
8. Disclosure Rule
9. Type of Census Canvass
10. Financial Costs

In setting up the criteria for the definition of a new area, the Bureau seeks the aid of all interested parties. Following the delimitation of individual areas, local reviews are made before the boundaries finally are approved.

Geographers can help the Census mainly in two ways: (1) by regional analyses of the United States employing statistical data to establish cores and boundaries, and (2) by critical analyses of the area concepts employed by the Census.

CLIMATE AND VEGETATION

CHARLES Y. HU—*Some New Climate Maps of China.*

The major concern of the paper is to analyze the mean annual precipitation map. There are six noticeable features on the map which deserve mention. First, the average annual precipitation of China decreases steadily from south to north. Second, compared to North and South China, there is even more consistent and sharper decrease of precipitation from the southeast to the northwest, i.e., from the coast to the interior (away from the source of moisture). Third, the effect of topography (particularly the Tsing-ling and the Nan-ling mountains) on the total annual precipitation is in general very pronounced and most highland areas of China have annual precipitation amounting between 1,500 and 2,000 mm. Fourth, in addition to the vast and continuous arid areas of Northwest China and the Tibetan Plateau, four relatively less humid islands amid wetter areas stand out on the map, including: (1) western Shantung; (2) northern Hainan; (3) central Szechuan; and (4) southeastern Yunnan (Kai-yuan basin). The relatively smaller precipitation in the first two areas is mainly due to the rain-shadow effect of mountains on nearby lowlands while that of the last two areas is a result of the sheltering influence of the

highlands surrounding the basins. Fifth, several very wet areas are discernible on the map, including: (1) highlands of western Szechuan; (2) south and southwestern Kwangtung; (3) eastern Fukien; (4) central Formosa; and (5) eastern Kweichow. The heavy precipitation in these areas are either due to orographic effect, or to the presence of semistationary front caused by rugged local topography or owing to the effect of typhoons. Sixth, many of the higher isohyets in Southeast China are often oriented northeast—southwest. This phenomenon is probably due to a combination of three influences: (1) the normal tracks of cyclones of east central China often run southwest-northeast; (2) the paths of typhoons, after reaching Chinese shores, frequently recurve toward the northeast; and (3) many highlands in east central China have northeast—southwest trendings.

After having constructed and studied these precipitation maps, one would be warranted in making the following three *tentative* generalizations:

First; the factors controlling precipitation in China are cyclonic influences, monsoonal circulation, topography, latitudinal positions with respect to major air streams, and distance from the sea. Particularly the influences of the normal tracks of extra-tropical cyclones and topography (notably the Tsing-ling and the Nan-ling highlands) on annual precipitation are traceable on the map.

Second, all types of rain are present in China.

Third, summer rains generally dominate on the continent, winter rains over the sea (especially on northern Formosa), and more-or-less uniform conditions of seasonal distribution along the Southeast China coast.

A. W. Küchler—*A Physiognomic Classification of Vegetation.*

On the basis of constructive criticism, the "Geographic System of Vegetation" (Geogr. Rev., April 1947) has been revised and improved. This is a classification of vegetation, based on physiognomy, designed primarily for the purpose of mapping the vegetation of the world uniformly. Formulas are used to denote the character of the vegetation. By keeping this method very flexible, it is adapted to all parts of the world and to maps of all scales.

David C. Winslow—*Geographical Implications of Niphometeorological Research in Western North America*

In the western portion of North America, interpretation of niphometeorological (snow measurement) data yields results of vital significance to dwellers on major watersheds by enabling them to make necessary adjustments to their environment. Practical application of snow survey forecasts and of related values derived from them throw light on the geographical implications of such scientific work in North America and elsewhere.

Practical utilization of snow surveys falls into eleven categories, as follows: (1) production of crops and hay, (2) application of irrigation water, (3) range control and planting of seeding, (4) forest protection and management, (5) stock-

ing and management of wild life and game fish, (6) storage of water and production of hydroelectric power, (7) control of flood waters, (8) operation of transportational services, (9) management of recreational facilities, (10) operation of mines and quarries, and (11) miscellaneous undertakings.

Snow forecasts may be divided as to usefulness into either seasonal benefits or long-period benefits. Seasonal benefits are worth while for the following: management of diversions and off-channel reservoirs; distribution of water to reservoirs and irrigated lands; handling of flood waters; maintenance of railroad right-of ways, automobile roadbeds, and structures; control of grazing lands; protection of forests against fires; apportionment of water for municipal and industrial uses; regulation of navigation and floating operations; catering to tourists; supervision of mines and quarries; and miscellaneous purposes.

Long-period benefits from snow survey data center about planning, construction, and operation of large-scale projects. Such information is useful to engineers in reservoir design and capacity studies, particularly in making provision for suitable types of spillways. Hydroelectric power installations, waterway improvements, and irrigation ditch re-alignments are made safer by such runoff considerations.

Although present applications of snow surveys appear important, there is envisaged a time when utilization will be considerably extended. Future work involves an expanded program so as to include establishment of additional snow courses, institution of longer periods of snow measurement, and enlargement of research projects in both facilities and numbers of personnel.

When the scientific world and the general public embrace the science of niphometeorology as whole-heartedly and as trustingly as they do other branches of meteorology, man's adjustment to his environment will have progressed another step forward.

ECONOMIC GEOGRAPHY

JOHN W. ALEXANDER—*Manufacturing in The Rock Valley.*

In the valley of the Rock River which flows southward through Wisconsin and northern Illinois there is a small but significant yet surprising manufacturing development. It is surprising because it seems out of place—out of place because the region lacks endowments which many manufacturing regions possess. It has no coal, insignificant water power, no large local market, no cheap water transportation, and scarcely any raw materials on which the Valley's industries are based. Yet industry has developed here to such a degree that the Rock Valley appears conspicuously on maps of manufacturing distribution in the United States; the pattern is that of a tongue of industry penetrating southwestward into the non-industrial portions of western Wisconsin and Illinois.

The dominant industrial activity is the secondary fabrication of metal products of which the leading items are machinery, hardware, and automobiles and automotive equipment. The major sources of raw materials are the primary steel centers

in eastern United States, and with but a few exceptions the major markets are likewise in eastern United States. The result is a movement of raw materials westward to be fabricated in the Rock Valley and then turned around for the return trip to eastern markets.

The major factors explaining the industrial development in the Rock Valley are:

1. An early start based upon two natural resources which now are unimportant: water power and timber.
2. A manufacturingly-inclined people who have played a four-fold role:
   a) inventive genius,
   b) productive labor,
   c) labor's working for wages slightly less than those paid in competing plants which have a locational advantage in eastern United States,
   d) willingness to supply capital freely to factories.
3. Location near enough to eastern raw materials and markets so that freight costs do not overcome the advantage in labor costs and productive skills which the Valley enjoys.

LYDA BELTHIUS—*Beaver Bay, Future Taconite Beneficiation Site.*

Beaver Bay, fifty miles northeast of Duluth on the north shore of Lake Superior, was successively a sawmilling center, a farming and fishing community, and a fishing and resorting village. It now expects an imminent growth due to its selection as a site for processing low grade ore called taconite.

This ore, which is found in large amounts in Minnesota and near Beaver Bay, has an iron content of from 25 to 35 per cent. To use this in smelting, it must be treated to concentrate the iron particles and remove the silica. This process is called beneficiation.

Taconite is to be used in the near future to replace the present high grade ore which is rapidly being depleted.

To process this ore, various improvements must be made. Plans call for the construction of a railroad from the ore site on the eastern end of the Mesabi Range to Beaver Bay on the lake. The plant to be constructed there will have equipment for crushing processes, magnetic separation, and the pelletization of concentrates. A hydro-electric plant will furnish power.

Harbor development will include a dock for concentrate and coal storage, breakwaters, and the dredging of a large basin. Water used for power production and beneficiation is to be returned to the lake with ore waste in suspension. A deep natural trough near the shore and parallel to it for several miles both ways will provide unlimited space for tailings.

The expenditure for taconite processing will be great. A two-unit project, the size being considered, will cost $77,000,000. Some advantages, however, are obtained by using low grade ore. Royalty rates and taxes are low and the concentrate will be 62 to 65 per cent iron by weight compared to 51½ per cent in present ores.

The opening of the proposed beneficiation plant at Beaver Bay is expected to bring year round employment to 1800 to 2000 men. One writer has estimated that if a 4-unit project is developed a community of 10,000 to 15,000 people will be formed. This larger plant would produce 10,000,000 tons of concentrate yearly or about one-sixth of Minnesota's average contribution the past ten years.

Taconite processing will make Beaver Bay a thriving community with a bright future.

DOUGLAS D. CRARY—*Irrigation and Land Use in Zeiniya Bahari, Upper Egypt.*

Zeiniya Bahari is a village on the Nile in Upper Egypt containing the three irrigation systems upon which Egyptian agriculture depends. These are the basin system, the perennial system, and the lift system. In Zeiniya Bahari the basin and perennial methods are dominant; lift techniques are largely supplementary. Specific crop combinations and land use practices are associated with the two major irrigation methods. Behind both irrigation technique and land utilization lies the Nile, not only as a source of water, but also as a controlling factor in agricultural activity. The other physical conditions of the landscape are subordinate to the works of man.

The Nile is in flood in late summer, occupying a period of approximately three months from first rise to final evacuation of the land. The basins are covered with water at this time. Forage crops (white clover, flat peas, fenugreek) and food crops (wheat, barley, cowpeas, and lentils) are sown in November in the mud left by the subsiding flood. Their harvest is completed by the following May. During the high water season the perennially irrigated area, not flooded, is producing a crop of sorghum or maize. This is followed by food crops (wheat, barley, and cowpeas), the harvest of which is also completed by the following May. The basin area thus produces one crop with one heavy watering, and the perennially irrigated land produces two crops with more or less continuous watering. In the summer season the land in both areas, with a few exceptions, lies fallow, not because of high temperatures, but due to the limitations of the water supply.

The basin lands of Egypt are giving way to the perennially irrigated lands. The present rapid increase in the population of Egypt has brought about an increase in the demand for food produced within a non-expandable area. Part of Zeiniya Bahari has already been converted to the two crop system. The rest will follow.

RAYMOND E. CRIST—*Geography, History, and Land Use in the East-West Valley of Southern Hispaniola.*

This valley, once a narrow arm of the sea, was in great part covered with excellent alluvial soil, the accumulated deposits of the Riviere Blanche in Haiti and the Rio Yaque del Sur in the Dominican Republic.

The French wrought wonders in the Cul de Sac Plain, the irrigable part of which they planted in sugar cane, on plantations manned by thousands of slaves. The French planters became very wealthy and some of this wealth seeped across

into the Spanish part of Hispaniola and rejuvenated the rachitic agriculture of that cultural area. The rich plantation export economy was destroyed in the slave insurrections between 1791 and 1805. The estates were parcelled out among the negroes who in 1805 established a republic. Subsistence farming replaced agriculture for export. Population increased apace.

On the Dominican side of the valley, in the Lake Enriquillo Basin there was almost no reflection of the pre-revolutionary prosperity in Haiti. Land was for the most part held in great landed estates, except for the alluvial fans of the small streams flowing into the valley, on which intensive farming on diminutive plots was practiced. But the large delta plain of the Yaque was abandoned to brush and goats. Population increase was slow. When technical know-how and large amounts of capital were available, this vast area was made highly valuable as a sugar cane producer.

The physical characteristics of the sub-humid east-west valley remain practically constant throughout its entire length, but differences in cultural backgrounds, in historical development and in land tenure practices account in large part for the marked cultural dichotomy found in this natural corridor.

LOYAL DURAND, JR.—*The Burley Tobacco Region of East Tennessee, Southwestern Virginia, and Western North Carolina: Correlation Between Tobacco Culture and the Small Farms of the Mountain South.*

The cultivation of burley tobacco dates from post-Civil War days. The great expansion of burley acreage did not occur,however, until the period of the 1920's, and has continued to the present.

Tobacco cultivation, almost a necessity upon the small farms of the Mountain South, is relatively more important as a cash crop to the small landowner than it is to the "large farmer." The intensive tobacco areas are all in regions of very small landholdings. Hundreds of these landholdings have been classified as subsistence farms in recent censuses, but they are now emerging as tobacco farms. The American economic setting has forced thousands of former subsistence farmers to seek an intensive crop for their landholdings, or else to migrate to northern industrial centers, or seek employment in the newly founded industries of the region—chemical, rayon, aluminum, and atomic energy.

Tobacco culture, originally localized in Greene County, Tennessee, has spread up and down the Folded Appalachian valleys of Upper East Tennessee and southwestern Virginia. It has "overflowed" northwestward into the rugged Cumberland Plateaus counties, especially near Cumberland Gap, and south and southeastward into the Unakas and Great Smokies.

Sixty-four large warehouses and auction floors, located in nine marketing centers, handle and sell the regional tobacco crop. The recent increase in the importance of burley tobacco to the farmers of the Mountain South is reflected in the fact that some of the present marketing centers did not possess warehouses until

after World War I, and in one city, with eight large warehouses at present, the first warehouse was not constructed until 1939. One hundred million pounds of burley tobacco are now marketed annually at the 64 warehouses, 44 of which are in six towns in Upper East Tennessee, 12 of which are in two towns of mountainous western North Carolina, and eight of which are in one city of extreme southwestern Virginia.

The southwestern margin of the region of intensive burley cultivation correlates with the general limit of the small landholdings of the Mountain South. Beyond this limit, where farms are larger in average size, the cultivation of burley tobacco is now spreading slowly to *small farms,* but the recent increase in regional production has been principally through continued expansion in Upper East Tennessee.

TIM K. KELLEY—*The Taylor Grazing Act and the West.*

The Taylor Grazing Act, passed in 1934, offered protection, management, and development of the Public Domain grazing lands, at a time when they had reached a bad state of deterioration due to unrestricted exploitation. Taylor lands were the "remainder" lands, never homesteaded because no one considered them worth the necessary, effort, and cost. Previous to the Act, conservation-minded stockmen could do little to stop abuse from over-grazing. The Taylor Act put an end to plundering; grazing privileges were apportioned; trespass livestock were largely removed; provisions were made for necessary range improvements and fire protection. As a result, 142,000,000 acres of the Public Domain have been protected and put to more orderly use. On-the-ground facts prove this Act to be one of the greatest proper land use acts ever passed so far as the West is concerned.

Grazing privileges have been instrumental in stabilizing the industry. Much of the watershed lands of the western rivers have received better management, so that more water may be harnessed for power and irrigation. Provisions have been made for the protection and management of wildlife.

As often happens, ambiguity of wording and lack of clarity of detail have been responsible for varying interpretations of the law by opposing factions. Too small a personnel was given the task of bringing proper use to millions of acres; sometimes one man supervised a million acres during the adjustment period.

Despite proof of the worthiness of this Act, opposition rose from the only citizen-group who seemed to know or care about the Taylor Act administration, the stockmen. A minority of the 21,630 ranchers using Taylor lands asked Congress to sell them the 142,000,000 acres of range at prices ranging from nine cents to $2.80 an acre. Due to unfavorable public reaction from many stockman, sportsman, conservation, and irrigation farming groups, maneuvers have changed. Emphasis is now placed on the dangers to private industry resulting from expanding governmental bureaus. This movement is even more dangerous, threatening not only the Taylor lands but National Forests and Parks. Thus the economy of much of the

West is endangered by a philosophy alien to multiple uses management. Again the question of public versus private ownership comes to the fore. Arguments exist for both sides. The citizenry must decide; too few understand public land policies. The entire public land question should be brought in unbiased terms before the public, weighed, deliberated, and a definite long range policy defined.

H. O. LATHROP—*Changes in the Corn Belt Landscapes.*

The landscape features of the Corn Belt have been delineated by many writers. Such delineations are subject to constant revision due to continuous changes in both the natural and cultural landscapes. Cutting farm woodlands, erosion, soil depletion, and lowering of the water table have greatly altered the natural landscape. Man's technological advances in farm machinery, plant and animal breeding, transportation facilities, and numerous uses of power have given a different aspect to the cultural landscape. The factors of both the natural and cultural landscapes have been mutually interactive on each other to produce a landscape quite different from that at the turn of the century.

Not only has there been a changing landscape but man and his way of life have also changed. Education, religion, and social life have shared in the inevitable change, and the philosophy of life in the Corn Belt is quite different from that at the turn of the century. Cause and effect have interacted to create new elements in the landscape.

Changes are noticeable in man-induced erosion, farm buildings, hedge fences, farm woodlands, power machinery, better roads, farm animals, decline of the rural school and the village church, changes in the Corn Belt village, the disappearing wind mill, soil erosion control practices, as well as in a variety of other ways. A wanderer returning to the Corn Belt after an absence of 40 years would find difficulty in reorienting his life to the changed conditions and the attending new philosophy of life.

EUGENE MATHER—*The Marketing of Wyoming Beef Cattle.*

Beef cattle production is important throughout Wyoming except in the extreme northwest and in most of the Wyoming Basin. Climatic and vegetative factors in the areas of beef production are in large measure responsible for the huge shipments during the fall. The age and type of stock marketed is affected greatly by production factors operative within local areas and even on indvidual ranches. Brand and health inspections of beef cattle indicate specific means by which cattle are sold, the relative significance of trucks and railroads in the transportation of beef cattle to market, and the distributional aspects of marketing Wyoming cattle. A notable trend is the expanding west-coast market, especially in California, for beef produced in areas that formerly supplied mostly eastern markets.

E. WILLARD MILLER—*Strip Mining—a Problem of Land Utilization in Western Pennsylvania.*

The development of strip mining in the recovery of coal has become important only in recent years due to the use of large earth moving equipment. The production of stripped coal in Pennsylvania increased from 2,792,000 tons in 1939 to 35,946,000 tons in 1947. Throughout most of the 1930's open pit output was less than one per cent of the total coal mined. The percentage began to rise rapidly in 1938 with the increasing production, and is now over 25 per cent of the coal mined in the state.

In recent years between seven and eight thousand acres have been strip mined each year in Pennsylvania. This overturning of the earth has created many problems. To the average citizen the most striking feature of strip mining is the destruction of the scenic beauty by the unsightly spoil banks along the highways. These are now common sights in western Pennsylvania. The destruction of productive farm land is also a major consideration. Strip mining operations are concentrated on level terrain and consequently some of the best farm land of western Pennsylvania is being destroyed. As long as profits obtained per acre by the farmer are more than 100 times the income of a single agricultural year, farm land will be sacrificed.

Erosion of the exposed earth in the spoil banks and the consequent silting of streams is a further problem. If the exposed face of the coal is not covered, water, which is highly acidic, usually seeps out of it. When this enters streams it kills most of the fish.

What can be done to reclaim the stripped areas? Until 1945 only a very small percentage of stripped land had been reclaimed, and it was felt a reclamation program would succeed only if it were state controlled. The Bituminous Coal Open Pit Mining Conservation Law now requires the strip miners to replant the area mined or forfeit a bond of $200 per acre.

The miners of Pennsylvania were largely opposed to the law, but are now conforming to its regulations since it has been proved constitutional. In 1946, 120,000 trees were planted on spoil banks and in 1948, 850,000 trees. However, this would plant only about 850 acres out of approximately 7,500 which were stripped in 1948. At the present time only two or three per cent of the total stripped area has been reclaimed. There are many problems yet to be solved and the initial law needs to be revised in the light of present field observations. However, one of the fundamental steps has been taken. There is now a recognition that a major problem exists, and that it must be solved if Pennsylvania is to maintain a permanently sound economy.

HENRY SOMERS STERLING—*The Emergence of the Medium-Size Private Farm as the Most Successful Product of Mexico's Agrarian Reform.*

Although Mexico's land reform program has largely destroyed the once-dominant

hacienda system, it has not equipped the majority of the survivors to adjust successfully to their altered status. By wholesale expropriation of hacienda land, and its redistribution, in tiny pieces, to the landless rural proletariat, the small-farm peasant class has now been enlarged to include roughly two-thirds of the rural population, or about 10 million people. This two-thirds, living largely in agglomerated settlements, new and old, has a present living standard little better than that of 1910. The nation's output of the chief rural food staples, corn and beans, has declined; while that of wheat has apparently not kept pace with the growth of population.

Meanwhile, a relatively privileged class of medium-sized private properties has been preserved and encouraged to multiply. It includes reduced remnants of the hacienda itself; many new farms created for the most part by subdivision of hacienda land to evade expropriation; and a sprinkling of older ones dating back to pre-reform days.

Even this elite class has not come through unscathed. During the disorderly first decade of the revolution many farmsteads were permanently abandoned. Illegal encroachments continued in the more stable period from 1920 to 1940. Many owners had difficulty in converting to the more intensive methods which were essential if they were to make a profit from their modest holdings. One solution has been to form, by rental or joint operation, functional farm units larger than any one owner could legally hold.

There are perhaps 200,000 "medium-size" farms in Mexico today, ranging in size and type from small owner-operated units of 25 to 50 acres, just a notch above the peasant village farm, to larger holdings up to several hundred acres in size, worked by hired field hands.

Where linked to nearby urban markets by reasonably good transportation, and endowed with enough good land, grown to cash crops under wise management, the more progressive medium-sized farms are the most successful products of the revolution. They have not only fallen heir to some of the capital, equipment and skilled farm management formerly at the disposal of the hacienda; but are usually operated more intensively and efficently than their predecessor, under the stimulus of smaller size, more modern equipment, and improved transportation to rapidly-growing urban markets. All of these factors, of course, place a premium upon larger per-acre yields and higher quality products, which make the medium-sized farm the chief source of agricultural commodities needed by Mexico's expanding urban and industrial markets. Although at times during the revolution its future has seemed doubtful, the trend during the last two administrations has been consistently toward a strengthening of its position.

GILBERT F. WHITE—*Geographic Problems in Natural Resources Administration.*

The Natural Resources Committee of the Commission on the Organization of the Executive Branch of the Government recently completed a study of possible ways of improving the efficiency and economy of the Federal administrative organi-

zation dealing with natural resources. Although the findings are not yet public, it is possible to make some personal comments upon trends and problems of special interest to geographers.

At least three major trends currently are apparent in Federal administration of natural resources: 1) the volume of Federal programs is increasing at an accelerated rate, 2) administration is grouped increasingly in regional units, and 3) more attention is being given to evaluation of proposed programs in terms of regional or national needs.

The crucial problems faced in administration of resources include 1) determining the wisest use of a given resource at a given time, and 2) selecting the most suitable social policy to encourage such use. Determination of wise use requires a comprehensive analysis including regional study. As more attention is given to regional administration and to project evaluation on a national scale, it seems likely that there will be increased demand for comparative studies of land use, for regional studies, and for appraisal of regional planning. These will be a growing challenge to geographic thinking.

GEOGRAPHIC METHODOLOGY AND THE WORK OF GEOGRAPHERS

GEORGE BEISHLAG—*What's Wrong With Geographic Writing?*

The Analysis

First. Tradition hampers good writing.

Second. Our vocabulary of standardized terms is not complete enough.

Third. There are too many people writing who haven't anything to say.

Fourth. Too many authors who do have something to say use hard-to-read-prose.

Four horrible examples are:

1. The over-user of modifiers.
2. The writer who can't organize.
3. The user of pseudo-professional jargon.
4. The lover of big words.

Some Propositions

One. Let's break with the tradition of thick "learned" writing.

Two. Let's work toward a standardized vocabulary of geographic terms.

Three. Let's demand lucid prose from geographic authors.

A Future Hope

When geographic writing becomes easy to read we will find the public will want more of our geographic interpretations.

JOHN WESLEY COULTER—*The Method of Science in Human Geography*

The word "geography" has been misrepresented and misused by being made to stand for what it does not mean. This confusion is due to its application to two academic disciplines which are distinct from each other. One, physical geography,

has to do with physical phenomena in the field of the natural sciences. Its field is well defined and its methodology worked out. The researcher in the field consciously or subconsciously asks himself, "How has such and such a land form come to be as it is in the world today?"

The other geography is human geography and has for its subject human beings. It is a social science with its roots, however, in the natural sciences. The student of that discipline tries to answer the question, How have human beings come to be as they are in the world today? Philosophy asks the question "Why?" Science asks the question "How?" The method of science involves only a few fundamental factors: accuracy in observation, verification of the facts, methods of induction and deduction, and intuition. The method of science was the method of Darwin.

In approaching human geography by the method of science, history is important. The human geographer cannot understand the present without enquiring into the past. The importance of the natural environment as a factor is generally agreed. In some cases the human spirit is the dynamic factor. The method of analysis must take into account the spiritual factor, look into the psychological and appreciate its force.

In approaching human geography with the "How?" question, the geographer avoids the strife regarding the delimitation of regions. However, several environments of mankind, closely interwoven, make it difficult to find the answer: (a) the natural environment commonly recognized by geographers (b) the cultural environment (c) the social environment of the community (d) the internal environment of man himself. In view of the numerous and complex causative factors with which a human geographer has to deal in any situation where there are so many human variables, the method of the multiple working hypotheses of Chamberlain offers the best guide to the conduct of the solution of a problem. It is logical to apply to human activities the laws of thermodynamics. The principle of the least action, a law of thermodynamics, can possibly, be applied in the field of human geography. Perhaps someone may be endowed with that flash of understanding which, by recognizing the connecting links between various lines of evidence, will find the answer.

FRED E. DOHRS (Introduced by G. Donald Hudson)—*Applications of the Motion Picture to Geographic Research*

Although well established in the fields of education and illustration, there has been relatively little application of the motion picture to basic geographic research. The motion picture makes it possible to study the dynamism of many processes, through its unique ability to record and to reproduce movement. In this, one of the most important attributes of the motion picture is the control of time, which may be of two types: fast motion or slow motion. Fast motion, that is, the speeding up of processes difficult to observe in detail due to the long periods of time involved is accomplished through lapse time photography. This is of primary importance in studying natural processes which are of long duration or slow movement.

It is also possible to record activities of man with the objectivity of the animated map through techniques of lapse time photography. The other time control feature of the motion picture is slow motion which is the slowing down of processes difficult to observe in detail due to the short period of time involved. Natural processes may be examined in great detail in the field or under controlled laboratory conditions.

One of the outstanding advantages in the use of the motion picture for geographic research is that it provides an objective recording of dynamic phenomena in a form that makes repeated observations possible. For photography is wholly objective in what it records; subjectivity is thus limited to the selection of the phenomenon and the point of view from which it is photographed. This objective recording is of great value for research in the urban scene, where the complexity of details, often makes it difficult to avoid overlooking significant items. Here the mechanical motion picture camera records these details completely for future study. In the geographic aspects of market research, the motion picture provides a quantitative and qualitative repeatable view including those details and actions difficult to assess in an on-the-spot situation. There is indicated a fertile field for the motion picture in geographic research, but further experimentation and field work are necessary to determine fully the applications and limitations of this tool.

PRESTON E. JAMES—*Formulating the Objectives of Geographic Research.*

The common denominator of geographical studies throughout the many systematic and regional fields is a preoccupation with the significance of differences from place to place on the earth. The word "significant" in this brief description of the field implies inquiry into both the causes of area differences and also into the consequences.

Within the broad field of geography, however, there are many kinds of objectives to be attacked. Not only for the sake of clear thinking on the part of writers of geographic reports, but also for the sake of the readers who are to evaluate what is written, it is essential that the objectives of a study be clearly stated in the opening paragraph. Generally speaking, three major kinds of research study are recognized: *exploratory* studies, where the problem is to find the means of gathering, organizing, classifying, and presenting geographic knowledge; *genetic* studies, where the problem is one of cause and effect relations; and *remedial* studies, where the problem is to define a condition which is unsatisfactory and to point to the desirable directions of change. Geographic research inevitably deals with categories of phenomena; and the selection and evaluation of categories must be done in terms of the conceptual framework which the workers bring with them to their tasks. It is highly important that the concepts which shape geographical studies be carefully thought out and precisely formulated.

SHANNON MCCUNE—*The Geographic Profession in Asia.*

From personal contacts and experiences as Corresponding Secretary for Asia of the A S P G and Chairman of the Committee on Asian Studies of the A A G,

this report on the characteristics, problems, and accomplishments of the geographic profession in Asia has been prepared. The geographers are few in number, weak in training, and widely separated. They occupy a fairly low status. They have many professional societies which lack strength. Despite their many problems, they have accomplished much. As evidence an exhibition of some of their published material has been prepared. American geographers are urged to embark on a definite program, submitted in some detail, which will encourage, aid, and strengthen their Asian colleagues.

GEOMORPHOLOGY

JOHN BRIAN BIRD (Introduced by D. F. Putnam)—*Shoreline Features of Northwestern Iceland.*

The fjords of northern Iceland contain many constructional beach forms. The commonest and most valuable in the economy of Iceland are the cuspate forelands. Previous investigators in the area believed their origin was linked very closely with the valley glaciers which occupied the fjords during the close of the Ice Age.

The fjord walls are made of basalt which is disintegrating rapidly by freeze-thaw action to form large screes. This talus and the post glacial raised beaches supply the material for the cuspate forelands. The rock debris is moved towards the fjord head by longshore drifting, currents having only a minor role. When an angle occurs in the otherwise straight shoreline a shingle spit develops. As the rate of growth decreases in the deeper offshore water, the spit recurves under the influence of waves developed by land breezes and a lagoon is enclosed behind the shingle ridge. The seaward side tends to change direction so as to lie at right angles to the dominant waves. Occasionally this is helped by the addition of more beach ridges, but normally the single ridge is eroded where it joins the fjord side. The inner side meanwhile grows by the addition of storm ridges. With the removal of material from the outer side and its deposition on the inner side the foreland appears to move towards the head of the fjord and the lagoon, becoming smaller, shifts to the outer edge. In the final stage the lagoon disappears and the foreland which initially is wide and curved becomes narrow and pointed. A submarine platform of boulders and smaller rocks remains to mark its former extent.

Historical evidence shows that the land in northwest Iceland is still rising following the diminution of the Ice Cap and that the present day forelands have formed rapidly in recent times. The eroded remnants of former forelands are, however, to be found in the raised beaches.

YIN T'ANG CHANG (Introduced by James E. Collier)—*The Trend in the Changes of the Yellow River Course and a Possible Solution for the "Sorrow of China."*

The Yellow River changed its course both in geological and historical times. It is the change of the lower course within historical times that has troubled the

Chinese most. Six changes have been recorded since 2,200 B. C. in addition to 1,580 times of flood.

The trend of its shift has been eastward. Each time it takes a ready river to the sea. Only one of the six changes was westward: that just to the Nan Yun Canal. All the rivers in the plain must have functioned as its distributaries in the past.

Overflow of the Yellow River and changes of its courses seem unavoidable under present conditions. Natural causes: (1) lacks a straight course, (2) too many meanders, (3) abrupt change of gradient, (4) loose texture of the loess, (5) rainfall too intense. Human causes: (1) lack of vegetation cover, (2) inadequacy of embanking.

Under such circumstances, discharge of all the torrential water of a drainage of 600,000 sq. miles through a single channel of 700 miles with a gradient of less than 1′ per mile is practically impossible.

A possible solution for the 'Sorrow of China' lies in a complete plan for the whole drainage area rather than a partial cure. In order to make the best use of all the geographical factors on a large scale, the following steps should be taken: In the North China Plain emphasize (1) restoration of the deserted distributaries which rise close to the Yellow River and have no obstacles separating their watersheds and (2) use the lake depressions in Hopei, Shantung and Kiangsu as natural overflow reserviors. Diverting the river into four or five channels will prevent overflow and concentration of deposition. In the Middle and Upper courses, (3) extensive reforestation to conserve the soil, (4) dams and reserviors should be built at topographically favourable locations for irrigation and hydro-power. This would reduce the volume of water in its lower course. At Lung-men alone, a dam 450′ high would store 13,000 million cubic metres of water, amounting to the average annual total flow of that place. Inundation can be avoided, if the flow is properly regulated at the dam.

Suitable locations for building dams and reservoirs exist elsewhere. A solution for the 'Sorrow of China' is not difficult to find, if the whole hydrography is considered and control of the river is planned to make the greatest use of all the geographical factors.

WILLIAM H. HOBBS—*The Pleistocene History of the Mississippi River.*

Throughout about one-half of its course the Mississippi River now flows within an area which during Pleistocene time was invaded by the frontal lobes of four continental glaciers in succession. Whatever may have been the course of the pre-Pleistocene river, it was displaced by these lobes four successive times, and during the receding hemicycle of each glaciation the river was swollen to gargantuan proportions by the icy meltwater of each liquidating glacier in its turn. It is now possible to map the river's course in each of these stages.

ARTHUR N. STRAHLER (Introduced by Shannon McCune—*Recent Developments in Quantitative Analysis of Erosional Landforms.*

Application of quantitative methods to the study of landforms and the processes which make them is a relatively new field and one which must be developed extensively if geomorphology is to attain a scientific level comparable to that reached by most other branches of natural science. Two examples of quantitative techniques in the analysis of erosional landforms are described below.

In the Verdugo and San Rafael Hills of southern California a high degree of uniformity prevails among the landforms on a maturely dissected mountain block of intrusive and metamorphic rocks. As one phase of quantitative analysis of this topographic complex 500 slope angles, measured on lower walls of small ravines, were subjected to frequency distribution analysis. Arithmetic means of 42° to 45° were obtained in various parts of the range. A high degree of homogeneity of slope angles is shown by standard deviations of 3° to 4° and by a range of 18° or less within each group. Frequency distributions are symmetrical and fit closely the normal curve of error. Slopes long protected from stream cutting, as evidenced by basal talus, were found to have a mean of 38.2° as compared with 44.7° for slopes which are being refreshed at the base by stream corrosion. The difference is highly significant and indicates declining, rather than parallel, retreat of protected slopes.

Hypsographic analysis of small drainage basins deals with the distribution of landmass volume in relation to elevation. Percentage hypsographic curves from various localities show an orderly series of changes from youth, through maturity to old age. A figure of reference is provided by a solid bounded on the sides by the vertical projection of the basin perimeter; above and below by parallel horizontal planes passed through the highest and lowest points of the basin. Of this volume, the part below the ground surface may be computed as the area below the hypsographic curve and is therefore named the subsurface integral. It is expressed as a percentage of the entire volume of the reference solid. Values range from about 80% in early youth to as low as 17% in old age and are between 40 and 60% in full maturity.

An exponential equation has been devised whose curves approximate the typical hypsographic curves. Thus for every drainage basin a theoretical curve can be fitted and the stage of development expressed as an exponent in the equation.

HISTORICAL GEOGRAPHY

RICHARD HARTSHORNE—*The Iron of Lorraine and the Franco-German Boundary of 1871.*

To what extent was the location of the Franco-German boundary of 1871 determined or influenced by the existence of the Lorraine iron ores? Examination of the official communications, the discussions of the German leaders among themselves

as well as with the French, and particularly of the maps showing the boundary as drawn at various stages between August 1870 and May 1871 leads to the following conclusions. The dominant positive factor was the strategic concern of the German military and of Bismarck to secure the fortress of Metz and the control of the Moselle route from Metz through Thionville toward Luxemburg and the Rhine. This necessitated inclusion of the east-facing escarpment located just west of the Moselle which contained iron ore deposits well known to be of considerable current value and the associated iron industries at the foot of the escarpment. The second-most important factor was the popular demand in Germany for the inclusion of all the area of eastern France that was German in culture and, more importantly, Bismarck's concern *not* to include large numbers of French-speaking people. The discussions among the German leaders were almost exclusively concerned with these two, somewhat conflicting factors. Only one passing mention of iron is found in any of their discussions until the final stages of the boundary determination when a mining engineer familiar with the Lorraine area was able to introduce that factor into the consideration. The successive changes made in the line, from the publication, in August 1870, of its first approximation in terms of existing political subdivisions of France, to the final demarcation in May, can almost all be recognized as determined by considerations of the strategic and ethnic factors. Certain changes were obviously called for to eliminate difficult salients in the line and two communes were added to include sites of major battles in the war where many German officers and soldiers were buried. In all, those concerned with the ore deposits may have succeeded in adding two or three communes that would not otherwise have been included in the annexation, on the other hand, and the personal interest of one of the French negotiators in one iron center resulted in the exclusion of that commune that would otherwise certainly have been included in the area annexed.

George Kish—*Some Aspects of the Missionary Cartography of Japan During the 16th Century.*

One of the main issues in the history of Japanese cartography has been the almost complete lack of maps of Japanese origin that have been used by European mapmakers during the 16th century. A considerable portion of the map intelligence material found on maps prior to 1600 came from missionary sources, mainly through the "Relations" written by Jesuits working in Japan. A map, found in 1931 in Florence, and most probably brought there by a Jesuit-organized Embassy to the Vatican, in 1585, may well provide this missing evidence of Oriental influence on Western cartography. This map clearly indicates, both in its shape and in the selection of place names and in other characteristic features that it is a copy of a Japanese original. It was, in turn, copied by several European maps published between 1580 and 1590, and most likely served as the principal source of Teizeira's map, the first detailed printed map of Japan, published by Ortelius in 1595.

RICHARD F. LOGAN—*Geographical Causes of Agricultural Abandonment in New England.*

It has long been realized that large sections of New England have been undergoing gradual abandonment agriculturally. The causes may be divided into two categories: attractive and repellant. The former have worked from outside the area, drawing people from the land. They are principally the City and the West.

The repellant forces are largely local in nature. They range from the truly geographic to others of economic and sociological natures.

On the peneplained surface of the crystalline uplands of New England, various geographic factors have acted as repellants. In southern Vermont, due to the high altitude (over 2000 feet) and the latitude, abandonment has been due primarily to climatic limitations. Short growing seasons and cold summers prevent the growth of corn, and hence preclude the development of the dairy industry, mainstay of New England agriculture. All types of soil, and all glacial features have been tried for farming and discarded. But in the valleys incised below the upland, warmer soils (gravels, etc.) are still in agricultural occupance.

Where the climate, due to more southerly position and lower elevation, is more conducive to argriculture—as in the west-central Connecticut uplands—soil becomes the determining factor. Certain soil types have remained in cultivation. Notable among them is the drumlin, with its sloping sides to shunt off excessive water in spring, its clayey soil to retain moisture through summer droughts, its relative freedom from stone, and its favorable shape for air drainage. In areas of thin soil and excessive boulderiness, abandonment has been the rule. Towns with large areas of drumlins have long histories of dairying (as Goshen, Connecticut); others possessing excessive extents of thin till and boulders, have reverted to second-growth forests (as Warren, Connecticut).

A third geographic factor of consequence is accessibility. Areas cut off topographically from easy outside communication find difficulty marketing their dairy products, especially during the period of heavy snows. This is more pronounced in predominantly-rural Vermont than in urban Connecticut, where the aid in road construction and maintainance available to rural communities from the State is large. Stemming from the factor of inaccessibility are other factors, many bordering on a sociological: lack of educational facilities, fear and loneliness, lack of opportunity.

Thus, an area is likely to be abandoned if it is below the minimum climatic requirements for corn production. If above them, thinness or stoneyness of soil or inaccessibility will discourage agriculture.

WILLIS B. MERRIAM—*Historical Geography of the Rogue River Valley, Oregon.*

Situated between two great valleys, the Willamette and the Sacramento, that were major goals of western migration during the middle decades of the nineteenth century, the importance of the Rogue River valley in West Coast history has been overshadowed.

Isolated within the Klamath Plateau of Southwestern Oregon it is prominent mainly because of an agricultural aristocracy based on commercial pear production.

The first white men to enter the valley were Hudson's Bay fur traders, from 1828 through the 1830's. While still the realm of the trapper it was used occasionally as a pioneer immigrant passageway, achieving a position as an immigrant cutoff from Fort Hall to Oregon City in 1846, and still further prominence as a trade-route passageway from the Willamette valley to California after the gold discoveries in 1848.

Two drivers on this route discovered gold near Jacksonville in 1851, thus starting a minor gold rush into southwestern Oregon. Farmers came in to supply the local market by 1852 and the settlement of the valley was under way.

In spite of the decline of boom-time mining after 1860, the region maintained itself as an agricultural center until the coming of the railroad lines in 1887 and the development of irrigation projects in 1906, encouraged the rise of the pear orchard specialization, frequently engaged in by wealthy investors from the East.

The Rogue River valley today is a region of relatively closed resources, but one which, based on specialized irrigated tree-crop agriculture, its associated mining, lumbering, and tourism, is a nuclear center from which, in spite of its isolation, emerges a distinctive cultural and regional personality.

EDWARD T. PRICE—*The East Tennessee Melungeons: A Mixed-Blood Strain.*

Of several racially mixed groups maintaining local identity in American society, the Melungeons, centering in northeastern Tennessee, are among the most scattered, most diluted with white blood, and hardest to find, but the reality of the group may be recognized by the general agreement of other people as to who belong to it. Probably between 5000 and 10,000 members of the group are recognized; most of these live in a few clusters where they usually form a class of laborers or Appalachian farmers with the economic status of the southern poor white and the partial outcast status carried with the name Melungeon. Only a minority of them can now be recognized by their brown skin and black hair, but most of the people classed as Melungeons bear one of small number of surnames which are known to have charaterized a community of 330 free persons of color in Hancock County, Tennessee, in the census year 1830.

The Melungeon racial background is not clear. Few of the lines show physical traits of the negro; Indian blood is entirely possible; persistent stories of Portuguese blood are not backed up by other evidence. The ancestors of the present Melungeons, apparently several families strong, crossed the mountains with the earlier settlers; their number grew by continued migration from North Carolina and Virginia and by intermarriage with other people. From Hancock County they appear to have migrated north and south, scattering through the country, but concentrating in several spots. A population surplus now drains off to work in cities,

but the Melungeons remaining in this slow-moving, rural society are likely to be identified for a long time to come.

GEORGE R. RUMNEY—*The Ottawa-Nipissing Canoe Route in Early Western Travel.*

In the literature of early North American travel, frequent references to the Ottawa-Nipissing canoe route between the St. Lawrence River and the Great Lakes, indicate that it was the most important canoe route to the west during the 17th and 18th centuries.

The lasting importance of this historic highway was primarily due to its function as an avenue in the fur trade, and to the widespread use among white men of the Indian's birch canoe. The Ottawa-Nipissing route was shorter than other routes into the Great Lakes from the centers of French settlement on the St. Lawrence, and in addition, the high forested banks of its lakes and rivers afforded protection from strong winds that frequently made the larger lakes unnavigable for canoes. Moreover it passed northward of the Iroquois country bordering Lake Ontario and the headwaters of St. Lawrence, where Iroquois war parties made it unsafe to travel for many years.

In little more than a half-century of exploration, voyageurs and missionaries of New France, traveling by way of the Ottawa River and Lake Nipissing, discovered all of the Great Lakes, and much of the adjoining territory, including the headwaters of the Mississippi River. By 1763, when French rule in Canada ended, missions had been established down the Mississippi as far as Kaskaskia, and a chain of fur posts had been built by the French that extended northwestward to Lake of the Woods, Lake Winnipeg, and Saskatchewan River.

After the British conquest, Scotch and English traders revived the commerce in furs throughout the former regions of French exploitation, employing the Ottawa-Nipissing route from Montreal to the west. As competition among them increased, many individual traders formed partnerships, the most important of which was the Northwest Company, founded in 1783. Northwest Company traders, such as Mackenzie, Harmon, and Fraser, setting out from Montreal up the Ottawa, explored for the first time much of northern and western Canada.

The expanded operations of the Northwest Company brought its men into more frequent contact with agents of the Hudson's Bay Company, who had been hunting furs from their principal base at York Factory on Hudson's Bay for more than a century. The lengthening distance between Montreal and the far-flung trading posts of the west, plus the rising costs of competing with its great rival from the north, so decreased the profits of the Northwest Company that it was forced to unite with the Hudson's Bay Company in 1821. Montreal soon lost its preminence in the fur trade to York Factory, and the importance of the Ottawa-Nipissing canoe route rapidly declined. By 1825 the Ottawa-Nipissing canoe route was virtually abandoned.

POLITICAL GEOGRAPHY

VEVA KATHERN DEAN (Introduced by S. Van Valkenburg)—*Geographical Aspects of the Newfoundland Referendum.*

On July 22, 1948, following an indecisive referendum on June 3, 1948, the electors of Newfoundland went to the poles to decide their future form of government. They cast 52.34% of their votes for Confederation with Canada and 47.66% for Responsible Government. On July 30, 1948 Prime Minister Mackenzie King accepted Newfoundland and Labrador as the tenth province of the Dominion of Canada.

For the plebecites Newfoundland was divided into twenty-four electoral districts and Labrador comprised one. Seven districts, all on the Avalon Peninsula, favored Responsible Government; eighteen districts, the remainder of the island and Labrador, supported Confederation with Canada.

The referendum significantly exhibits the collapse of control long exercised by St. John's and its satellite "outports" on the Avalon Peninsula.

Since Newfoundland's population is predominantly of British stock it would seem that union with Canada would be popular; but Irish elements appeared to support Responsible Government. The three main religious groups—Church of England, Roman Catholic, and United Church of Canada—are arranged around the coast in almost pure denominational groups. Several districts on the Avalon Peninsula, which are predominantly Catholic, were strongholds of Responsible Government.

Another factor that influenced the vote cast for return of dominion status is the concentration of 89.5% of all local industries on the Avalon Peninsula; employers and employees feared competition from well-established Canadian firms. Disregarding the threat of competition from Canadian fisheries and the fact that Canadian fisheries are administered from Ottawa, the fishermen of the sixteen districts beyond the Avalon Peninsula supported Confederation. Apparently the welfare services offered by Ottawa to the provinces—family allowances, old age pensions, etc.—outweighed other factors in certain sections of the island.

The six or seven million dollars spent annually by the United States on our Newfoundland bases does wonders to bolster the economic stability of the country. A Party for Economic Union with the United States—especially strong on the Avalon Peninsula—advocated a return to responsible government so that an independent Newfoundland could approach Washington on a "new Bases deal."

ERIC FISCHER—*The Small Nation in the Present World.*

Today the problem exists whether small nations can survive as genuine individualities in a world where technological progress in economy and military weapons obviously favors large states and administration of larger areas has become easy. If this is true it is an anomaly that small states have actually increased in considerable numbers during the last 50 years. To the new independent states

those autonomous and semi-independent states should be added which had no comparable status 50 years ago. On the other hand several small nations have sunk to the status of satellites. The few unions of formerly unconnected nations have not materially changed the status of their member nations. A reason for this apparent anomalous persistence of small nations has to be found. The small countries can be grouped according to origin in 4 groups: 1st. A few emerged from a fusion of several closely related primitive tribes into a higher political unit. 2nd. Ideological consciousness induced small nations to break away from large empires. Nationalism is the most important such ideology at present. It has even proven an obstacle to complete absorption of several satellite states. Such ideologies have changed and this fact accounts much more for the disappearance of many small nations than the physical power of other nations. 3rd. Some relic states of former empires have acquired a sense of separate nationhood only after their creation. 4th. Buffer states are kept independent by the rivalry of neighboring larger nations. All these state building forces are still effective for the promotion of the small country, as are the opposing technological forces which work for the creation of giant or large body politics. This battle of opposing forces is fought in time and space. Time provides the historical conditions. Location is a condition, but not the cause, for the better or worse chances of survival of small nations. That implies that areas of favorable condition are not necessarily occupied by small states. A small nation has also under present conditions prospects for genuine separate life, even discounting the protection of a strengthened UN. District nationality can develop under favorable conditions and human factors, like nationality, are able to assert themselves.

WILLIAM H. HOBBS—*The Problem of a Trans-Isthmian Canal.*

By resolution of the Congress in 1945 either the construction of a new trans-isthumian canal must be begun in 1948 or the capacity and security of the present one must be greatly increased. A committee of engineers appointed to study the problem has recommended the second alternative, through converting the present Panama lock canal to a sea-level one.

It is here shown that a sea-level combined open ditch and tunnel canal across the Tehuantepec Isthmus in Mexico is feasible, and would be much less vulnerable, while securing many advantages and at no greater cost.

ROBERT B. JOHNSON—*Political Salients and Transportation Solutions: as Typified by Eastern North America and Manchuria.*

"Political salient" as used in this paper refers to an area under the control of one state which obstructs communications desired by another. In such a situation four possible transport solutions are open to the blocked power:

1. It may circumvent the salient by developing an alternate route, often "all-national." (e.g., Leningrad-Murmansk, Moscow-Archangelsk.)

2. Where boundaries permit, it may develop a "short-cut" across the salient. (e.g., the Alcan Highway, or the lines of the New York Central in southern Ontario.)
3. When necessary or expedient it may develop an international route using the facilities of the other state. This may involve "in transit" agreements, actual ownership of transport facilities, or "free port" arrangements. (e.g., Switzerland-Genoa, Prague-Hamburg).
4. Where alternate arrangements are unsatisfactory, the blocked state may resort to territorial annexation or boundary readjustments. This is a stronger form of the last alternative. (e.g., the "Polish Corridor.")

Two examples of this problem, northeast Asia and eastern North America, are examined in detail.

In Siberia there is the all-Russian Trans-Siberian, the Chinese Eastern short-cut, and the international route of the Chinese Eastern Railroad and South Manchurian Railroad to Dairen. The other lines of Manchuria are all of southern (Chinese or Japanese) origin and serve predominantly local interests.

In eastern Canada and northeastern United States is a similar but more complex pattern. The Canadian National Railway routes from the Province of Quebec are all-national by-pass routes. The Canadian Pacific Railway across Maine is a short-cut and there are numerous north-south lines across New England and eastern New York from Canada, both Canadian and American owned.

The similarities in these railway networks is not due to parallel growth, but evolve quite differently. There is, however, a similarity in political configuration and location. The variations in these networks seem related to basic geographic differences.

In conclusion, in both New England and Manchuria all three peaceful solutions to the problem of a salient are to be found, and in Manchuria the fourth solution is partly present in the Russian concessions of the Kwantung Peninsula.

H. L. KOSTANICK—*Macedonia: Problem in Political Geography.*

Since 1947, the Macedonian problem in northern Greece has been of direct interest to the United States, which replaced Great Britain in Greek, and, hence, Balkan affairs under the Truman Doctrine. Macedonia is a critical area not only in the Greek situation but also because both on a local and international scale it is representative of the basic features inherent in other territorial problems of the Balkans and much of Eastern Europe.

Politically, Macedonia is a major problem area of the last hundred years. The problem arose in the middle of the nineteenth century as a movement to gain independence from the Ottoman Empire. Actually, this was soon sublimated to individual Bulgar, Greek, and Serb efforts to annex entire Macedonia to their own state. Since World War II, Yugoslavia and Bulgaria have seemingly combined in an effort to gain control of Greek Macedonia.

Locally, four factors are fundamental in the situation. Macedonia is strategically located on the northern edge of the Aegean Sea and is the hub of Balkan land routes, of which the most important is the Morava-Vardar Corridor from the Danubian Basin to the Aegean Sea. The overt basis of territorial claims was the ethnic complexity prior to 1923. Ethnic controversy centered on the question of nationality of the Macedonian Slavs, who, as a transition group, had Bulgar, Yugoslav, and Greek characteristics. Successful exchange of population after 1923 have simplified ethnic structure. A third factor is the increased value of Greek Macedonia, since 1923 one of the most productive agricultural areas of the Balkans. The fourth factor is the historic ties of Macedonia with Bulgaria, Yugoslavia, and Greece.

Historical intervention in the Balkans by foreign powers has greatly affected local events. Great Britain, Russia, Austro-Hungary, and Germany have been the historical participants. At present, the United States and the U.S.S.R. are the powers most directly involved—the U.S. in Greece, and the U.S.S.R. in Yugoslavia, Bulgaria, and Albania.

Control of Greek Macedonia would give Yugoslavia and Bulgaria strategic access to the Aegean Sea and a valuable economic unit, but would raise the problem of Greek irredentist and territorial claims. On the other hand, Yugoslavia and Bulgaria apparently will not be satisfied without control of Macedonia. Thus the problem remains current both locally and internationally.

HEROLD J. WIENS—*Spotlight on China's West.*

The amount and quality of land communications give a measure of the political, cultural and economic progress of an area. It is of significance, therefore, to examine the state of land communications between China's Northwest and Southwest, regions whose undeveloped resources have awakened great interest among the planners of China's economic development.

Separating China's Northwest and Southwest and thwarting the advantageous exchange of their specialized resources and commodities is the Central Mountain Belt comprised of the rugged Ch'in-ling Shan and Ta-pa Shan ranges. Yet for over a thousand years in ancient times the importance of good north-south communications caused the Chinese state to maintain good roads between the Wei Ho Valley to the north and the Szechuan Basin to the south of this mountain barrier. To the Szechuan Basin these roads brought the culture, arts, and techniques of the northern Han civilization. From its rich lands the Chinese state drew important material support.

In more recent centuries, however, certain historical events and geographical changes led to the neglect of these channels of communication and to the decay of the mountain roads. China's preoccupation with her eastern and seaboard development led her to neglect her western interior.

During the last decade, however, the importance of the Ch'in-ling Shan north-south roads has been re-discovered. The war with Japan and the political and

economic threat of Soviet Russia have forced China to take action to remedy the defect of poor land communications across the mountain barrier.

To be significant, such action must include the construction of motor highways and railroads. These depend upon both engineering feasibility and the ready availability of fuel for power. The war-time surveys and construction have shown the feasibility of motor and rail transport across the mountain belt. Furthermore, both coal and hydro-electricity can be made available for use to run rail transport. In fact,construction has been underway on transmontane connections betweeen the Northwest and Southwest since the end of the war, while a highway now connects the two regions.

The significance of the completion of modern land communications lies in the facilitating of industrialization and the extension of trade in both Northwest and Southwest, in reducing the danger of famine in the dry Northwest, and, by making available the abundant man-power and material resources of Szechuan to the Chinese administration quickly when needed, in helping to stabilize the political uncertainties which beset China's northwest with its mixture of heterogeneous peoples and cultures.

REGIONAL GEOGRAPHY

BENOIT BROUILLETTE—*The Geographical Regions of Southern Quebec*

This is an essay on the regional geography of Quebec. A general map of the southern inhabited part showing three main divisions, A, B and C and their subdivisions; the latter are better shown in a series of 14 maps of individual regions.

The main divisions are based largely on the physiographic features, while the smaller regions are chosen according to their relative importance in human and economic geography.

Those maps will be incorporated in an Atlas of the Economic Geography of the Province of Quebec.

RAYMOND E. MURPHY—*"High" and "Low" Islands in the Eastern Carolines.*

This paper is a study of the contrasts between "high" islands and "low" as observed by the writer in the eastern Caroline Islands of the U. S. Trust Territory of the Pacific Islands. Ponape and Kusaie, two volcanic islands, are contrasted with Pingelap and Mokil, two atolls.

There were found to be a number of physical contrasts: (1) Ponape and Kusaie are high and rugged, the atolls are low and flat. (2) The volcanic islands have a moderately productive tropical soil; the atolls have no soil at all in the ordinary sense of the word. (3) The "high" islands are more compact in shape and, unlike the atolls, the "high" islands have good natural harbors. (4) The "high" islands have much greater total land areas. (5) The "high" islands have more rain than the atolls and average slightly lower temperatures. (6) There are surface streams on the "high" islands but not on the atolls. (7) The "high" islands have deposits

of bauxite; no mineral deposits on the atolls. (8) The natural vegetation of the "high" islands is much richer.

A number of cultural contrasts may be enumerated. Traditionally, the atoll dweller has had closer associations with the sea. Explorers, traders, and missionaries seem to have been more interested in the "high" islands than in the atolls. So, too, were Spaniards, Germans, and Japanese. The atolls have been largely left alone, a fact that worked to their advantage in World War II.

Agriculturally, the "high" islands have a number of advantages over the atolls. They have a much greater variety of crops, and even some cattle raising is possible.

Because of excessive population density, the atolls have become areas of emigration. The "high" islands, especially Ponape, have room for more people. Planning the future of the "high" islands in such a manner as best to promote the welfare of the native peoples of both the "high" islands and the atolls presents one of the most challenging problems that the United States faces in the eastern Carolines.

ROBERT S. PLATT—*Reconnaissance in Dynamic Regional Geography: Tierra del Fuego.*

The Andes and the Atlantic coastal plain of South America come to an end in Tierra del Fuego at the southern tip of the continent. The main island is commonly divided into two regions: a northern area of grassy plains occupied by sheep ranches and a southern area of wooded, snow-capped mountains.

A description based on such regional generalizations, elaborated and multiplied, may provide much information about Tierra del Fuego as a mosaic of areas distinguished on a basis of static homogeneity. But for an understanding of the island from the viewpoint of human occupance in its areal setting, additional analysis of another sort is needed, involving areas distinguished on a basis of dynamic organization, in accordance with procedures adopted in microgeographic field studies.

The pattern of dynamic organization in Tierra del Fuego includes a system of sheep ranches, established and managed by people from Scotland and manned by laborers from Chile; packing plants and ports functioning with reference to the sheep industry; an international boundary across the island, placed in accordance with political interests from Buenos Aires and Santiago and functioning increasingly to cut the island economy into separate subdivisions.

J. LEWIS ROBINSON—*Problems of Arctic Geography in Canada.*

The Canadian Arctic, one-third of Canada, is a challenge to geographers in *all* fields. The task of organizing, analyzing and correlating the new information being assembled is not an easy one.

In physical geography contributions will be made in mapping the distribution of new physical features as they are discovered, and showing their relationships to world patterns. A main problem now being attacked is the plotting of sea-ice conditions on regional maps. New techniques and more detailed information have

permitted an over-all picture of ice conditions in the Arctic Islands during the potential navigation season, affecting future transportation policies.

The relationships between the Eskimo and their environment are usually simple and direct. Civilization is rapidly encroaching upon the primitive Eskimo, however, and few remain as closely linked to their environment as formerly.

Economic geographers are needed to plot potential resources and apply principles of general economics and transportation. What part can the Arctic play in Canada's economic development, population policies, and defense measures?

Regional geographers must describe the natural environment, indicating its possiblities and problems. To date the sub-regions of the Canadian Arctic have been divided only into Eastern and Western Arctic.

The physical geography of the Arctic presents many problems of accessibility to geographers. Field work must therefore proceed slowly.

Progress is being made in studying these problems. The Canadian Government hired its first geographer in 1943. The Geographical Bureau, organized in the Department of Mines and Resources, Ottawa, in 1947, is concentrating its attention on Northern Canada. Georgraphy at Canadian Universities is giving attention to Arctic Canada.

EDWARD L. ULLMAN—*Rivers as Regional Bonds: The Columbia-Snake Example.*

Many types of rivers serve as regional bonds, but two spectacular types highlight this connecting function as follows: 1) rivers flowing through mountains from one side of a range to the other, such as the Potomac, and, 2) rivers flowing across deserts such as the Nile. The Potomac is an important transport corridor and bond; the Nile is an even more important bond, not so much because transport parallels it, but rather because it supports a continuous band of population, forming a living bridge across the barren Sahara.

Such rivers are so noteworthy that they deserve special names. The term *exotic* can be extended to apply to all streams crossing deserts. For rivers crossing mountains no satisfactory terms exist. *Dioric* (from the Greek "through mountains"), is proposed as a descriptive name for such streams.

The Columbia-Snake Rivers in the United States cross two clearly defined mountain masses and deserts, and furnish contrasting examples of the effect of *dioric* and *exotic* streams.

The Lower Columbia provides the only water level crossing of the entire Cascade-Sierra Range, and is followed by two transcontinental railways and highways, as well as providing a water route for barges and a flyway for birds and airplanes. The Upper Columbia crosses the desert Columbia Plateau, but is entrenched in a canyon so deep that its waters have not yet been used for irrigation; as a result the relatively level Columbia Plateau has sparser population and highway traffic than even the Cascades themselves.

The effect of the Snake is the reverse. In its *dioric* course through the Seven

Devils Mountains of Idaho it has cut a canyon so steep and precipitous that it is a barrier, rather than a bond. The *exotic* Snake, on the other hand, is somewhat comparable to the Nile. At places water has been diverted from its less deeply entrenched portions, and at other places from neighboring tributaries, resulting in a chain of irrigation settlements across southern Idaho.

Thus the *dioric* Columbia and the *exotic* Snake are important regional bonds, while the *dioric* Snake and *exotic* Columbia are not. The relative effect of the segments, however, is not static. The completion of the Columbia Basin irrigation project using water from Grand Coulee Dam, for example, will fill in the desert and the *exotic* Columbia will become an important bond.

STEPHEN S. VISHER—*Regionalization of Indiana.*

Although Indiana is relatively small and uniform in elevation and in most other respects, it possesses sufficient regional contrast so that on the basis of most common criteria of regionalization, three or more regions can be recognized. Maps are shown of the regions on 16 bases, including geology, topography, soil, climate, vegetation, productivity, farm types, population, urbanization. As Indiana is a fairly representative state, some of the bases and methods found useful here may have suggestive value to persons interested in the regionalization of other areas. The several subdivisions of Indiana on each of these bases are characterized. A composite, compromise of the 16 sets of regions is proposed.

URBAN GEOGRAPHY AND CITY PLANNING

ROBERT E. DICKINSON (Introduced by George B. Cressey)—*Aspects of Urban Morphology in France.*

This paper deals with the mode of formation of certain main types of urban habitat in France—the bishop's town that developed inside a Gallo-Roman nucleus; or as a newly fortified cathedral nucleus; the burgesses' town that developed round a secular stronghold as in Flanders and northern France; the more irregular plan that emerged among the towns of the Midi; the castle town; and the bastides of southwestern France. Some of the broad contrasts in the morphology of the towns of the Nord and the Midi are discussed.

SUPRAKAS GHOSH—*The Urban Pattern of Calcutta, India.*

The city of Calcutta is located at 22° 34′ N. latitude and 88° 22′ E. longitude, on the east bank of the Bhagirathi-Hughly, about 86 miles from the sea. The importance of Calcutta is due to its excellent position at the mouth of the vast Ganges valley. It is situated on a navigable river and has good communications with its productive hinterland. Politically, Calcutta, is the capital of the province of West Bengal, in the Union of India; economically, it is the focus of trade and commerce of all eastern India; and culturally, it is the center of modern life of Hindu Bengal. The present municipal Calcutta has a population of over two million.

The city was not built according to any plan; and with a density of population of over 100,000 to the square mile, it is now hopelessly congested. At the present time, however, due to inflation, high wages, increase in the cost of building materials and dearth of capital goods, reconstruction work is a difficult venture.

On a functional basis the city can be divided into the following areas: (1) Fort William and surrounding park; (2) Administrative and Commercial "Core"; (3) Foreign Residential Section; (4) Old Residential District; and (5) Newer Residential District.

The street pattern is very irregular, and in spite of an extensive network of streetcar and bus routes, the condition of the means of conveyance leaves much to be desired.

Filtered drinking water is obtained from a point 17 miles up the River Hughly, while unfiltered water is tapped from the river close to the city. Underground sewage is carried eastward by a series of conduits to the salt marshes where it is discharged to undergo oxidation.

Like most other metropolitan areas, Calcutta has its big share of slums located mostly in the eastern and southern parts. Planned improvement of the city is a dire need, but cognisance must be taken of several physical handicaps facing such development, as, for examples, its location on a levee, the wide stretches of salt marshes in the east, the soft unconsolidated soil and high water-table.

GEORGE W. HARTMAN—*The Central Business District—a Study in Urban Geography.*

A study is made of central business districts of certain cities in the United States in an effort to formulate spatial patterns and associations. The latter are then used as guideposts for analysis of local factors which tend to produce variations among individual districts.

Central districts tend to assume a central position with respect to all potential customers, and intensive use is made of the land base. Under the assumption that commercial activities select sites as close as possible to the central core of the internal and external activities of the city, idealized configurations are diagrammed and analyzed. A circular pattern is most effective in carrying out the functions of commercial activities if streets and buildings are ignored. Under a radical system of streets, however, the central district assumes a starlike pattern, and a grid system of streets tends to produce a tilted square or diamond. A comparison is made of these patterns with idealized trade-area configurations, and it is suggested that a circular or star-like district conforms to the hexagonal trade area, while the diamond is related to the square-shaped hinterland.

Local factors serve to produce considerable variation in actual shapes of central districts. These variations may be due to irregularities in the land base, in the method of platting streets and blocks, and in the flow of traffic along streets and highways. The shapes of central districts also may be affected by other factors,

among which is a weakening on the part of certain enterprises of their desire for absolute central position with respect to all potential customers. The conclusion is reached that actual shapes of central districts result from local factors that serve to distort in varying degree the tendency for symmetrical arrangement.

DAN STANISLAWSKI—*Anatomy of Towns in Mexico.*

The problem of the quality of a town, or perhaps better said, the personality of a town is one of the most interesting but likewise one of the most elusive. In a highly organized, well-documented section of the world like Northwestern Europe and its cultural appendages there are greater complexities due to industrialization and intensification of industrial processes. This is made comprehensible however by reason of great statistical information.

Latin America lacks both the complexity of industry and also the statistical information. Because of this another technique of investigation seems possible, that of recording the activities of single family dwellings. Inasmuch as the storekeeper, the craftsman, the person offering services as well as the administrative official all live and work in their dwelling the problem is simplified.

A record can be made of each separate dwelling unit within a town (not in the great metropoli which, obviously are patterned after northwestern Europe and the United States). The distribution of the simple categories of activities within the town shows with reasonable accuracy the character of the town in terms of items of production and, because of the position of activities within the town, the attitude of the group toward specific activities.

These attitudes vary in terms of the cultural bases of the group. They can be generalized into three classes: Hispanic, that which is based upon cultural attitudes imported from Iberia, Indian based upon attitudes and activities indigenous to the region and long pre-dating the Spanish conquest, and thirdly, a blend of the two that shows a combination of both Hispanic and Indian traits but in attenuated manner.

This cultural classification was made obvious only after the "anatomy mapping" was completed. The study was commenced with the idea that the towns would be grouped according to geographical regions. Such a conclusion proved untenable.

BOGDAN ZABORSKI (Introduced by Benoit Brouillette)—*How a Geographer Visualises a Street Pattern in a Planned City.*

The nets of streets in cities created during former centuries are not statisfactory for modern traffic. In order to avoid congestion waiting at street crossings which involves loss of time and discomfort a new network of streets is proposed. It is derived from the radial system such as is noticeable in the plan of several old cities. The pattern is "waved" out of two elements with one way traffic only, of a set of midly undulated avenues, connected by S-shaped streets. The streets will approach avenues nearly tangentially, merge in them for 200′–300′ and diverge in the same way. To avoid continuous "meandering" on long distances, it is proposed to con-

nect the odd avenues (where necessary) by streets, which will pass above even avenues on viaducts (and vice-versa). Also additional two-way roads, laid on a lower level might prove useful in certain cases.

Every four premises will have their interior private lanes, connecting two avenues (or avenue and street). Thus, instead of parking on the streets cars will enter premises, improving deliveries. Inhabitants' cars, leaving premises will be able to join avenues or streets in the required direction.

Parts of the town where avenues are getting nearer to each other are foreseen for business areas; regions where they become more distant may have several green spaces between two roads of houses, recreation grounds, parks etc. The focal points from which avenues are diverging in four main directions are foreseen for railway stations. When the town is growing there is a possiblity of enlarging the built-up spaces without affecting the network of streets. A plan of a larger city can be composed by the connection of several plans of urban units. The enclosures give the idea of a plan of a city in which several business districts and railway stations are marked.

The aim of this paper is to challenge discussion amongst geographers and town-planners with regard to the improvement of the network of the streets.

WILBUR ZELINSKY (introduced by John B. Leighly)—*Town Patterns in the Eastern United States.*

This is a preliminary attempt to define the morphological types into which the cities and villages of the eastern United States can be grouped and to describe the distribution of these town patterns. A tentative division of the area into regions with fairly homogeneous settlement characteristics is proposed and a few indications of the causative factors behind the distribution phenomena are offered. The information used in this study was gathered from all available large scale topographic and planimetric maps, and the coverage, while only partial, is sufficient to show most of the important facts. After the inspection of a number of representative maps, and the elimination of a number of categories of settlements, e.g., hamlets, suburbs, and most resort and mining towns, five town patterns were recognized: (1) the New England street village, (2) the linear town, (3) the clustered town, (4) the sub-rectilinear town, and (5) the grid town. All towns that were recorded from the available maps were assigned to these five categories, and then a distributional map for each type was drafted. These distributions are described and discussed. Perhaps the most interesting question encountered in this discussion arises from the abundance of grid towns in Pennsylvania; and the need for historical studies of that area's settlement geography is indicated as a prerequisite for an understanding of the origin and history of the American grid town. On the basis of a composite map which shows what town patterns are dominant in the areas covered, four and possibly five regions with rather uniform settlement characteristics are described: the New England region, a Pennsylvania region, the Middle Western region, and the South, with a possible sub-region in the Appalachians.